SCIENCE ABSTRACTS.

Section A.—PHYSICS.

FEBRUARY, 1932.

GENERAL PHYSICS.

288. Determination of the Yard in Wave-Lengths of Light. A. E. H. Tutton. *Roy. Soc., Phil. Trans.* 230. *pp.* 293–322, *Sept.*, 1931.—The British Imperial standard yard has been evaluated in wave-lengths of the red hydrogen line H_α, the yellow line of Ne_e and the red line of cadmium, Cd_r, the latter by calculation from the experimental results of H and Ne. The author's interferential method was used employing Grayson-ruling fiducial marks of only half-wave-length thickness, the author's interferometer and the Tutton comparator. Cd light was not used directly because of the necessary heating of the tube. The results obtained for the Imperial Standard Yard at 62° F. and 760 mm. pressure are (*a*) 1393290·5 wave-lengths of H_α; (*b*) 1562408·6 wave-lengths of Ne_e; and (*c*) 1420209·8 [calculated from (*b*)] or 1420210·6 [calculated from (*a*)] wave-lengths of Cd_r, or 1420205·9 if Houston's value for H_α is used instead of the author's. The value obtained from Ne light is considered the more accurate. The results obtained by Sears, Johnson and Jolly in a comparison of the yard and meter non-interferometrically lead to a value 1420210·5 wave-lengths for Cd_r. The procedure is explained in detail and the results obtained are tabulated and necessary corrections applied. Possible errors are discussed. R. S. R.

289. Accuracy of Measurements with the Torsion Balance. R. Schumann. *Zeits. f. Instrumentenk.* 51. *pp.* 426–430, *Aug.*, 1931.—In geodetic measurements with a torsion balance the mean errors of places which serve for the calculation are required as well as the mean errors of reduction. The errors due to heat radiation and air currents in the building are obviated partly by calculation and partly by instrumental precautions. Unavoidable small oscillations are less troublesome. Consideration is given to the remainder in the production of observations, when, working with many azimuths, superfluous observations are obtained. Finally, remarks are added on the influences of changes of zero. R. S. R.

290. New Suspension Arrangement for the Foucault Pendulum. R. Pozdeña. *Zeits. f. Instrumentenk.* 51. *pp.* 430–434, *Aug.*, 1931.—For use with these very long and heavy pendulums the Cardan suspension was an improvement on the old method, but trouble arises from rolling along the point of support, from temperature changes altering the contact at the point of support, and from wear and tear. A new type of suspension is described in which a cast-iron cup, of 10 cm. dia. and thickness, and having a broad flange, is supported in a cylindrical boring of the horizontal cross-beams in the upper part of the dome. The suspending wire consists of thick steel, copper covered, and fixed to another support resting on ball-bearings inside the cast-iron cup. This arrangement gives rotation in the horizontal plane and free rocking or oscillation in any direction, while temperature changes cause no trouble, and wear and tear is decreased. The arrangement is suggested as suitable for ships' chronometers or compasses. R. S. R.

291. Barometer Calibration with Self-Acting and Registering Arrangement for Pressure and Suction in any Intervals. W. Grundmann. *Zeits. f. Instrumentenk.* 51. *pp.* 476–479, *Sept.*, 1931.—Particulars are given of a pump which is used in testing aneroid barometers in order that allowances may be made for the elastic after-effect of the box or controlling spring. Diagrams illustrate the action of the pump, contact manometer and arrangement of stopcocks. R. S. R.

292. Manometer for Low Pressures in Easily Condensible Gases. T. G. Pearson. *Zeits. f. phys. Chem.* 156. *Abt. A* 2. *pp.* 86–88, *Sept.*, 1931.—Describes a manometer for easily condensible gases, which works well to ± 0·005 mm. A. D.

293. High-Vacuum Pressure-Control Apparatus. T. L. Ho. *Nat. Acad. Sci., Proc.* 17. *pp.* 548–550, *Sept.*, 1931.—The pressure in the system, A, in which the high vacuum is to be controlled is measured electrically by a galvanometer, the moving needle of which actuates another current passing round an electromagnet. This in turn acts on a piece of iron, B, floating in mercury in one side of a U-tube, the other side, C, of which is connected by a branch tube with a reservoir, D, containing gas at suitable pressure. The top of this side connects with A. As the iron, B, rises or falls the mercury in C falls or rises, opening or closing the connection with D. C. A. S.

294. Improved McLeod Gauge. S. D. Bryden, Jr. *Rev. Sci. Instruments*, 2. *pp.* 514–518, *Sept.*, 1931.—A " short form " of McLeod gauge has been designed and built which is believed to be an improvement over the conventional constructions. These improvements consist of a simplified and compact construction of the compression chamber and mercury cistern, and of the entrance of the tubing connecting the gauge with the vacuum system directly through the top of the compression chamber. The actual construction is shown by a drawing and photograph. The theory of the McLeod gauge is briefly considered and the possible advantages of combining a controlled compression or expansion chamber with several existing gauges are indicated. AUTHOR.

295. Valve Relay and Race Timer. W. M. Roberds. *Rev. Sci. Instruments*, 2. *pp.* 519–521, *Sept.*, 1931.—A description of a relay requiring only 1 μA and which operates in a few thousandths of a second. Used in conjunction with a photoelectric cell the circuit has been used as a race timer [see Abstract 2900 (1931)], and it is suggested that with slight modifications the device could be used for timing work in the laboratory where a high degree of accuracy is necessary. A. H.

296. Laminar Movements of Viscous Incompressible Liquids. A. Rosenblatt. *Accad. Lincei, Atti*, 14. *pp.* 93–99, *Aug.*, 1931.—Treats the case of periodical perturbation from initial repose which vanishes exponentially at infinity. This admits of exact treatment, and gives an infinite series of characteristic equations as well as an important limiting equation. E. E. F. d'A.

297. Centre of Hydrostatic Pressure. A. Masotti. *Accad. Lincei, Atti*, 4. *pp.* 99–103, *Aug.*, 1931.—For a solid completely immersed in a liquid the centre of hydrostatic pressure lies on the vertical line containing the centre of gravity of the solid. Its level on that line has a simple relation to the "plane of charge," as the author calls the plane situated at a distance $p_0/g\mu$ above the free surface of the liquid, where p_0 is the atmospheric pressure and μ the density of the liquid. E. E. F. d'A.

298. Application of Interferometer Methods to Problems of High Velocity Flow. R. Tremblot. *Comptes Rendus*, 193. *pp.* 418–419, *Sept.* 7, 1931.—The distribution of densities in a Laval *tuyère*, determined by the method previously described [see Abstract 2147 (1931)], indicates the correctness, within 1 %, of Müller's conclusions (at constant heat), as opposed to those of Prandtl, Steichen and Stodola (truly adiabatic flow). The interferometer was also applied to the study of the density of a current of air of velocity 500 m./sec. around an obstacle consisting of plates of metal of varying shapes, and the shock waves so produced. C. A. S.

299. Motion of Fluid about a Cavitation. H. Poncin. *Comptes Rendus*, 193. *pp.* 481–482, *Sept.* 28, 1931.—The author discusses mathematically fluid motion in the neighbourhood of a cavitation of permanent form described in a previous paper [see Abstract 2914 (1931). J. S. G. T.

300. Body with Negative Resistance in Aerodynamics. G. A. Crocco. *Accad. Lincei, Atti*, 13. *pp.* 906–911, *June* 21, 1931.—A mathematical treatment of a special case in the theory of propulsion by reaction, in which mechanism is replaced by a simple application of heat to the working fluid, generally air. J. W. T. W.

301. Air Resistance of Projectiles. P. S. Epstein. *Nat. Acad. Sci., Proc.* 17. *pp.* 532–547, *Sept.*, 1931.—The case of a quadrangular plane moving in the direction of its greatest diagonal with velocity exceeding that of sound is first considered, with reference to Riemann's and Prandtl and Meyer's treatments of the problem. The result is then extended to a polygon, and thence to a convex body of three dimensions, and compared with experimental results and other formulæ. C. A. S.

302. Air Resistance at the Rear of a Projectile. Depreux. *Comptes Rendus*, 193. *pp.* 439–440, *Sept.* 14, 1931.—The present work discusses the paper by Gabeault [see Abstract 3312 (1931)] and shows that the two facts demonstrated by him correspond to the same physical phenomenon, *viz.*, discontinuity for $V = A_0$ and the angular point for $V = 2A_0$. After reviewing the position it is shown that the experimental knowledge is vindicated in the case of $V > 2A_0$; the retraction of the bottom does not better the ballistic properties of the shell, since the quantity of movement imparted per sec. by the turbulences is proportional to the rear section. This fact is in accord with the presumed disposition of the said turbulences. S. G. B.

303. Diffusion in Metals. G. v. Hevesy and W. Seith. *Zeits. f. Elektrochem.* 37. *pp.* 528–531; *Disc.*, 531, *Aug.–Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May*, 1931.—A summary of work on this topic in which it is pointed out that the diffusion is brought about mainly through the movement of one of the metals only. F. J. W.

304. Passage of Gas through the Walls of Pyrometer Protection Tubes at High Temperature. W. F. Roeser. *Bureau of Standards, J. of Research,* 7. *pp.* 485–494, *Sept.,* 1931.—After a brief discussion of the contamination of thermocouples resulting from the use of tubes which are not gas-tight, the results of the measurements of the rate of passage of air through 36 tubes of refractory porcelain (11 different classes), 2 of fused silica, 1 of pyrex glass, 2 of alundum, and 15 of metal are given for various temperatures which the tubes would withstand without noticeable deformation. Methods of testing are described and a very brief discussion given of the processes by which air may pass through the tube walls. The results also indicate the degree of vacuum obtainable in porcelain tubes at 1400° C. AUTHOR.

305. Streaming of Rarefied Gases through Capillaries. W. Klose. *Ann. d. Physik,* 11. 1. *pp.* 73–93, *Sept.* 2, 1931.—Previous work, and particularly that of Warburg, Knudsen and Gaede [see Abstract 1245 (1913)] is critically reviewed. The laws of streaming have so far been confirmed only for very low and very high pressures, and an apparatus has therefore been devised for examining streaming at intermediate pressures, *i.e.,* such that the mean free path is of the same order as the diameter of the tube. The results obtained for nitrogen with tubes of 1–3·5 mm. radius confirm Knudsen's empirical formula. H. F. G.

306. Compressibility of Matter. G. Vitali. *Accad. Lincei, Atti,* 13. *pp.* 903–905, *June* 21, 1931.—Applies a result of F. Hausdorff to obtain a mathematical interpretation of the compressibility of matter. The paper is mainly mathematical and cannot be usefully abstracted. J. W. T. W.

307. Cohesion. J. E. Lennard-Jones. *Phys. Soc., Proc.* 43. *pp.* 461–482, *Sept.,* 1931.—Fields of cohesive force are of four types, *viz.*: (*a*) van der Waals' fields; (*b*) homopolar fields, as met with in chemistry; (*c*) ionic fields, due to the migration of an electron from one atom to another; and (*d*) metallic fields. The new wave-mechanics provides a ready explanation of (*a*) as an average attraction due to chance variations of the electron distribution. The resulting polarisation is not of a static character, but may be thought of as caused by the tendency of electrons in systems of this type to move in phase. With certain simplifying assumptions it becomes possible to find the law of force for simplest atomic models. An attraction varying inversely as the seventh power of the distance is found, while there is evidence that when the atoms are much closer a repulsion ensues, varying as the thirteenth power of the distance, approximately. When homopolar fields are considered, the employment of the new methods leads to a new term in the expression for energy. This "exchange" term, which depends on the spin of the electrons, has a large influence on the force between small atoms. Finally, it is possible to represent the electron probabilities by diagrams; these give an adequate picture of asymmetrical atoms like the halogens, and throw much light on electron affinity and ionic fields. In a general way also, metallic cohesion may be brought into the scheme. J. P. A.

308. Strain-Energy Function for Isotropic Bodies. C. Kaplan. *Phys. Rev.* 38. *pp.* 1020–1029, *Sept.* 1, 1931.—The strain-energy function ϕ

is assumed to be made up of a sum of homogeneous polynomials of the first, second, third, etc., degrees in the components of the strain tensor $e_{\alpha\beta}$. The expansion is carried only so far as to include the third degree group of terms, and then this expression for ϕ is studied from the point of view of the isotropy of space. Isotropy of space having been defined by means of rectangular trihedrons (or orthogonal ennuples), the effect on the "structure-tensor" $c^{\alpha\beta\gamma\delta\rho\sigma}$ (which forms with $e_{\alpha\beta}$ the third degree terms) of the assumption of isotropy is obtained. It is found that the third degree group introduces, for a completely isotropic state, only two coefficients of elasticity, which when taken together with the corresponding Lame's coefficients λ, μ of the second degree group gives only four elastic moduli in the complete expression for ϕ. The expression for ϕ thus developed is introduced into a set of equations obtained by Murnaghan [see Abstract 1022 (1929)] connecting the stress and strain components by means of ϕ; and so we obtain relations between stress and strain which are applicable to deformations of higher order than those allowed by Hooke's law. These latter relations are then applied to the case of normal and uniform compression, and these further applied to Bridgman's experiments on the change of volume of sodium under pressure at 30° C. In this application the four elastic moduli are reduced to two. AUTHOR.

309. Stress Distribution in an Angle Plate. Z. Tuzi. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, Nos.* 316–324. *pp.* 140–146. *Sept.*, 1931.—In a previous paper [see Abstract 2887 (1928)] the author investigated the distribution of stress in a compressed angle-plate of glass, by the photoelastic method. The isoclinals found appeared to show three singular points near the inner boundary of the angle. This conclusion was challenged, and the author now repeats and verifies the former results. The photographs of the isoclinals in question are reproduced. J. P. A.

310. Nature of Cracks and Fissures. T. Terada. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, Nos.* 316–324. *pp.* 159–171, *Sept.*, 1931.—The analogy, pointed out in a previous publication [see Abstract 3691 (1931)] between electrons and the propagation of cracks in a strained plate is reconsidered more fully here. The study of such cracks may become a means of investigating the surface energy of solids. Analogies with other discontinuous phenomena are noted. J. P. A.

311. Form and Growth of Cracks in Glass Plates. M. Hirata. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, Nos.* 316–324. *pp.* 172–195, *Sept.*, 1931.—In this profusely illustrated paper the gradual formation, by means of temperature gradients, of cracks in glass plates is studied in detail. In certain cases an attempt is made to calculate the surface energy of the glass from measurements of the total length of crack produced in an experiment, but the result is several hundred times the commonly accepted value. This is due to the complicated nature of the new surfaces so formed. J. P. A.

312. Vibrations of Quartz Plates. R. B. Wright and D. M. Stuart. *Bureau of Standards, J. of Research,* 7. *pp.* 519–553, *Sept.*, 1931.—Numerous modes of vibration of 0 and 30 degree cut circular and rectangular crystalline quartz plates were studied experimentally. Various methods were employed in studying these modes which are piezoelectrically excited. The behaviour of lycopodium powder applied to the vibrating faces proved to be the most fruitful source of information. A number of photographs of the patterns thus formed are produced and described. Although of limited utility, two mechanical devices also were employed in these studies. The direction of maximum radial displacement was determined for the two active lower frequency modes of 0° circular plates. It was found that these directions are nearly parallel to directions of critical values of Young's modulus. Facts were disclosed concerning specially oriented rectangular plates and rods. Experimental values of Young's modulus based on vibration frequencies of the latter were found to agree closely with corresponding values computed from a known theoretically derived expression. Rough experimental verification of the direction of one of the critical values of Young's modulus was obtained. Equations are derived for the modulus of rigidity and Poisson's ratio for crystalline quartz as functions of orientation, and graphs of these two functions as well as of Young's modulus are given. Methods are indicated, which may prove advantageous, of rigidly mounting quartz plates.

AUTHORS.

313. Accuracy of Internal Survey of a Measured Room. P. Werkmeister. *Zeits. f. Instrumentenk.* 51. *pp.* 396–400, *Aug.*, 1931.—The determination of the coordinates (x, y) of a point with reference to a straight line was measured between three points P, A and B on the line, on one hand with reference to PA $(= a)$ and PB $(= b)$, and on the other to the angles POA $(= \alpha)$ and POB $(= \beta)$. If the accuracy of x and y be found in the form m_x and m_y, then these are produced by the mean errors m_a and m_b of a and b and m_α and m_β of α and β. By the law of propagation of errors the total errors can be expressed as

$$m_x = \sqrt{\Delta x_a^2 + \Delta x_b^2 + \Delta x_\alpha^2 + \Delta x_\beta^2} \quad \text{and} \quad m_y = \sqrt{\Delta y_a^2 + \Delta y_b^2 + \Delta y_\alpha^2 + \Delta y_\beta^2}.$$

These eight partial errors can be determined in pairs on the basis of a simple geometrical consideration which is set out mathematically. R. S. R.

314. Crystal Structure of Carbides and Borides. M. v. Stackelberg. *Zeits. f. Elektrochem.* 37. *pp.* 542–544; *Disc.*, 545, *Aug.–Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May*, 1931.—The following carbides are found to be tetragonal face-centred, with four molecules to the unit cell: CaC_2, SiC_2, BaC_2, LaC_2, CeC_2, PrC_2, NdC_2, SmC_2, $NaHC_2$, KHC_2, ThC_2. YC_2 is probably hexagonal with two molecules to the unit cell. Be_2C has the fluorite structure, while the hexaborides of Ca, Sr, Ba, La and Ce are cubic with one molecule in the unit cell. The B_6 group is octahedral, but apparently not homopolar.

F. I. G. R.

315. Crystal Structure of Sodium Nitrite, $NaNO_2$. G. E. Ziegler. *Phys. Rev.* 38. *pp.* 1040–1047, *Sept.* 1, 1931.—Investigation by means of powder, rotation and Laue methods. Lattice body-centred, orthorhombic, containing two molecules. The dimensions of the cell are: $a = 3\cdot55$ Å.; $b = 5\cdot56$ Å.; $c = 5\cdot37$ Å. The angle between the N–O bonds = 132° (compared with Zachariasen's prediction of 120°). Data disagree with a linear nitrite group. The optical constants are: birefringence (positive) $= 0\cdot294 \pm 0\cdot013$; axial angle, $2V = 75°$ approximately; indices of refraction, $\alpha = 1\cdot354 \pm 0\cdot010$, $\beta = 1\cdot460 \pm 0\cdot010$, $\gamma = 1\cdot648 \pm 0\cdot003$. F. I. G. R.

316. X-Ray Investigation of Cyclohexane Derivatives. Parts IV and V. T. N. White. *Zeits. f. Krist.* 80. 1–2. *pp.* 1–17, *Sept.*, 1931. *In English.*—Part IV gives a detailed account of results already published [see Abstract 2937 (1931)]. In Part V the following data are given:

Substance.	Crystal Class.	Unit Cell.					Density.	Space Group (Probable).
		a	*b*	*c*	β	No. of Mols.		
Cyclohexane α-diol-1 : 2	Orthorhombic	7·62	8·55	19·57	—	8	1·182	$V_h^{15}(D_{2h}\,p\gamma a\beta)$
Cyclohexane γ-diol-1 : 2	Monoclinic prismatic	19·13	9·92	7·23	103·9°	8	1·147	$C_{2h}^{6}(C_{2h}\,ba1)$
Cyclohexane β-diol-1 : 4 (trans-quinitol)	Monoclinic prismatic	6·32	21·2	7·27	96·0°	6	1·18	$C_{2h}^{5}(C_{2h}\,pn2)$
β-cyclohexyl diacetate-1:4	Monoclinic prismatic	13·56	5·83	6·72	107·4°	2	1·146	$C_{2h}^{5}(C_{2h}\,pa2)$

The γ-diol-1 : 2 was prepared according to Brunel's method for his β-isomeride, but differed from his description thereof, and is hence designated γ. C. A. S.

317. Density and Structure of Millerite (Rhombohedral Nickel Sulphide). N. H. Kolkmeijer and A. L. T. Moesveld. *Zeits. f. Krist.* 80. 1–2. *pp.* 91–102, *Sept.*, 1931.—The elementary cell (rhombohedral) has an edge-length of 5·636 Å. and an angle of 116°35′0. It contains three molecules of NiS. The radii of the atomic domains are: sulphur, 1·6 Å.; nickel, 0·7 Å. The density of the compound at 18° C. is 5·348. F. I. G. R.

318. Why Crystals Exist. F. Zwicky. *Nat. Acad. Sci., Proc.* 17. *pp.* 524–532, *Sept.*, 1931.—The author's views on the secondary or mosaic structure in crystals [see Abstract 3014 (1930)] are recapitulated, and the hypothesis put forward that the sharp transition points, accurate lining-up of atoms, and existence of phases in general in crystals are to be attributed to some type of simultaneous cooperation of many elementary particles. The force required to effect this represents an additional amount of energy which may explain deviations from Dulong and Petit's law. Such cooperation may also explain the permanent electric and magnetic polarisations in crystals, Dehlinger's theory of hooking together (*Verhakung*) [see Abstract 838 (1930)], and possibly superconductivity, transition points indetectable by X-rays, and the effect of impurities. C. A. S.

319. Formation of Mixed Crystals in Molecular Lattices through Molecular Exchange. L. Vegard. *Zeits. f. Physik*, 71. 7–8. *pp.* 465–472, *Sept.* 3, 1931.—Discusses a number of molecular lattices of volatile substances (therefore at low temperatures), and selects the system CO_2—N_2O for X-ray investigation, for the reason that the edge-lengths of the elementary cells differ sufficiently to make measurements feasible. By exchange of the molecular units mixed crystals can be formed, and the change in edge-length is subject to the law of additivity. Corresponding experiments with H_2S and H_2Se are in progress. F. I. G. R.

320. X-Ray Study of the Magnetic Character of Liquid Crystalline p-Azoxyanisol and a Comparison with the Isotropic Liquid. G. W. Stewart. *Phys. Rev.* 38. *pp.* 931–942, *Sept.* 1, 1931.—The effect of a magnetic field on the orientation of liquid crystalline groups in *p*-azoxyanisol is studied by an X-ray method. The relative number of the groups orientated perpendicular to the field is obtained from two theories, one assuming a permanent magnetic moment and the other anisotropic polarisation. The experiments are in harmony with the second theory. The magnetic effect was markedly reduced by slow rotation of the vessel containing the liquid crystal and by increasing the number of cycles in an alternating magnetic field. The intensity of the principal X-ray diffraction maximum is 10 % greater in the liquid crystal than in the transparent liquid. This is explained by the existence of cybotactic liquid groups, the further grouping of which produces the liquid crystal. This also explains the marked optical but small X-ray difference between the two states. The liquid is microscopically never isotropic, but the cybotactic groups are too small for the effect of the magnetic field on the transparent liquid to be measured. C. B. A.

321. Increase in Surface Area due to Crystal Faces Developed by Etching. L. Tonks. *Phys. Rev.* 38. *pp.* 1030–1039, *Sept.* 15, 1931.—The fact that the surface of an etched crystalline body is made up of crystal faces means that the actual surface is greater than the apparent surface. The ratio of increase in area to apparent area is called the face excess. Given the available crystal faces and the orientation of the crystal, both the criterion for determining those faces which give the least face excess and two methods for calculating the face excess have been worked out. Assuming random crystal orientation and minimum face excess, the face excesses in the cases where (1) cubic and dodecahedral, (2) dodecahedral only, (3) cubic only, and (4) cubic, dodecahedral and octahedral faces are available have been calculated. The face excesses are, respectively, 0·129, 0·225, 0·500, and 0·0882. Certain cases involving preferred orientation are also discussed. AUTHOR.

322. Diamonds with Quartz Inclusions. C. W. Correns. *Zeits. f. Krist.* 80. 1–2. *pp.* 37–44, *Sept.*, 1931.—The specimens are from Brazil, and show lamellæ of quartz, mostly arranged along {111}. They are not unique crystals, and must have formed later than the diamond. The question of solution medium is discussed, according to the two reactions $C + CO_2 \rightarrow 2CO$; or $H_2O + C \rightarrow CO + H_2$. The equilibrium constant (in the gaseous state) for the first equation is $2{\cdot}6 \times 10^{-8}$, and for the second $0{\cdot}97 \times 10^{-6}$. The data refer to graphite, but are applied to the diamond, since the heat of transformation is very small. F. I. G. R.

323. Oscillation Method for the Determination of Crystal Hardness. W. D. Kusnetzow and E. W. Lawrentjewa. *Zeits. f. Krist.* 80. 1–2. *pp.* 54–62, *Sept.*, 1931.—A minute steel prism forms the " bob " of a pendulum, and is allowed to graze the surface of the crystal under test. The amplitudes and logarithmic decrements are observed, from which the hardness is deduced. The results agree, in the main, with accepted values, but considerable accuracy is possible. Crystals from solutions show a lower hardness than those from the melt, while the " damping " of the pendulum depends upon the direction of vibration. F. I. G. R.

324. Accurate Determination of the Dimensions of Crystal Lattices. N. H. Kolkmeijer and A. L. T. Moesveld. *Zeits. f. Krist.* 80. 1–2. *pp.* 63–90, *Sept.*, 1931.—Detailed account of experimental arrangement to insure exact centering of the specimen in the Debye-Scherrer camera. Application to the case of rock-salt. F. I. G. R.

325. New Calibration Methods in Accurate Determinations of Lattice Constants of Polycrystalline Substances. F. Regler. *Phys. Zeits.* 32. *pp.* 680–687, *Sept.* 1, 1931.—Technical and experimental details, enabling the work indicated by the title to be carried out with primary radiation which is not exactly parallel. F. I. G. R.

326. Lattice Constants, 1931. M. C. Neuburger. *Zeits. f. Krist.* 80. 1–2. *pp.* 103–131, *Sept.*, 1931.—Tables of the following data for the chemical elements: edge-lengths of the elementary cells, lattice structure, atomic weight, ordinal number, density and atomic radius, atomic working sphere, packing density, volumes per atom and atomic volumes. F. I. G. R.

327. Isotopes of Lithium, Sodium and Potassium. K. T. Bainbridge. *Frank Inst. J.* 212. *pp.* 317–339, *Sept.*, 1931.—The author has found by magnetic analysis of the positive rays of lithium, using a method in which the ionic currents were not limited by space charge and the ions of the isotopes were brought in turn to the receiving slits by exactly the same path, that there is no change in the relative abundance of Li^7 and Li^6 with temperature. This agrees with the results of Aston and of Morand, but differs from those of G. P. Thomson, Dempster and Hundley. Results are given for five alkali-metal ion sources, and for barium and strontium. If Na^{21} or Na^{25} exist at all in addition to Na^{23} there can only be less than 1/3000 of the latter, and Na^{22} cannot be more than 1/800 of the Na^{23}. There is less than one part in 1500 of K^{43}, less than one part in 600 of K^{42}, and less than one part in 300 of K^{40} in reference to K^{39}, if they exist at all. K^{41}, the radioactive isotope, appears distinctly in the author's experimental curve. H. N. A.

328. Molecular Structures from Optical and Electrical Data. E. Bergmann and L. Engel. *Zeits. f. Elektrochem.* 37. *pp.* 563–569; *Disc.*, 569, *Aug.–Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—The author first discovers the simplest molecular model which can interact reciprocally with an electric field, and then applies his results to different types of compounds. It is shown that the dipole moments of all substances investigated of the type AX_3 are different from zero, which indicates for them a pyramidal structure. Similarly, bodies of the type AX_4 have a pyramidal structure, and those of type AX_5 have a four-sided pyramid with quadratic base in whose five corners are the X-atoms. The dipole moments of benzophenone, *p*-chlorobenzophenone, and *pp*′-dichlorobenzophenone are also compared and discussed alongside other organic compounds, including triphenylmethane and tri-*p*-nitrophenylmethane. Finally, condensed ring systems such as 2:6-dichloronaphthalene, fluorenone, 2-nitrofluorenone and fluorenone-4-carboxylic acid are examined. The method is claimed as a reliable means of ascertaining precise stereochemical information. H. H. Ho.

329. Determination of Mean Molecular Weights of Lubricating Oils by Improved Cryoscopic Methods. N. G. Gullick. *Inst. Petroleum Technologists, J.* 17. *pp.* 541–571, *Sept.*, 1931.—Two types of lubricating oils were used, Venezuelan and Pennsylvanian, and the viscosity, refractive index, flash-point, specific gravity and setting point were also measured. Two methods were employed for determining the mean molecular weight from the freezing-point depression: (*a*) with platinum resistance thermometers, using nitrobenzene dried with Na_2SO_4 as solvent, and (*b*) using benzene, dried as before, for solvent, and mercury (Beckmann) thermometers for the temperatures. In series (*a*) the curve of apparent molecular weight against concentration was useless for extrapolation to zero concentration, so that it is concluded that nitrobenzene is unsuitable as a solvent. The benzene results gave slanting straight lines and are satisfactory. Reasons are given for considering that the slope is due to association and not to the formation of mixed crystals. J. H. A.

330. Avogadro's Number from Brownian Movement in a Torsional Pendulum. E. Kappler. *Ann. d. Physik,* 11. 2. *pp.* 233–256, *Sept.* 11, 1931.—From a quartz fibre of about 10 μ dia. and a few cm. long is suspended a small mirror, inside a sufficiently small enclosure. Owing to Brownian motions in the fibre, the mirror executes small random torsional displacements, which by a reflected beam of light are recorded on a moving photographic film. If the mean square of the displacement is ϕ^2, and the torsional constant of the suspension is D, then $D\phi^2 = kT$, where k is the Boltzmann constant and T the absolute temperature. The best conditions for performing the experiment are studied, various disturbing influences are eliminated, and a determination of k is made. From this, Avogadro's number is found to be $60 \cdot 59 \times 10^{22}$. The experiment is to be improved. J. P. A.

331. Principle of Free Rotation in Molecules having a Simple Carbon Combination. C. Wagner. *Zeits. f. phys. Chem.* 14. *Abt.B* 2. *pp.* 166–168, *Sept.,* 1931.—It is deduced from the specific heat of ethane that the two methyl radicals have no free rotation in respect of each other, but have instead a periodic oscillation. J. K.

332. Electronic Structure of Nitrogen Peroxide. W. A. Noyes. *Zeits. f. Elektrochem.* 37. *pp.* 569–571, *Aug.–Sept.,* 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—By means of spectroscopic data Mecke has recently shown that the two oxygen atoms in NO_2 are differently united to the nitrogen atom, *viz.,* O = N–O–. The present author arrives at the same conclusion on chemical grounds. H. H. Ho.

333. Molecular Energy Levels and Valence Bonds. J. C. Slater. *Phys. Rev.* 38. *pp.* 1109–1144, *Sept.* 15, 1931.—Electronic energy levels in molecules are discussed, by the same methods previously used in discussing atomic levels. The problem in general is much more difficult than for atoms, and less progress can be made toward quantitative solution. For the lowest electronic level in cases where there are definite valence bonds, however, approximate solutions can be set up which should be fairly accurate, and which lead to a definite verification of the ideas of the writer and of Pauling regarding directed valence and the importance of concentrated bond functions. A number of special cases are discussed, involving both spin and orbital degeneracy. [See also Abstract 2501 (1931).]

AUTHOR.

334. Structure of Layers Arising from Molecular Rays. K. Coper, L. Frommer and H. Zocher. *Zeits. f. Elektrochem.* 37. *pp.* 571–577; *Disc.,* 577, *Aug.–Sept.,* 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—With the exception of boron trioxide, all inhomogeneous substances here investigated (silver, gold, copper, platinum,

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cadmium, lead oxide, boron trioxide, sodium chloride, silver chloride, calcium fluoride, and chromium trichloride) form layers of non-spherical particles which show a marked tendency to build themselves transversely to molecular radiation. The mechanism of orientation is discussed.

H. H. Ho.

335. Molecular-Ray Problems. Researches with Monochromatic de Broglie Waves of Molecular Rays. I. Estermann, R. Frisch and O. Stern. *Phys. Zeits.* 32. *pp.* 670–674, *Sept.* 1, 1931.—A nearly monochromatic beam of He atoms, obtained by diffraction from a LiF crystal, is passed through a slit and allowed to fall on a second LiF crystal. The beam diffracted by the second crystal exhibits maxima at positions which agree with the wave-lengths calculated from the position of the slit, and the height of the maxima corresponds with the expected Maxwellian velocity distribution of the atoms. A monochromatic beam is also obtained by the use of two rapidly rotating toothed wheels placed in the path of an ordinary atomic beam. This beam then falls on a LiF crystal. From the position of the diffraction maxima, the grating constant of LiF, the velocity of rotation of the wheels, their distance apart and the number of teeth, it is possible to make a very exact test of the de Broglie equation $\lambda = h/mv$.

J. E. K.

336. Reflection of Mercury from Alkali Halide Crystals. H. A. Zahl and A. Ellett. *Phys. Rev.* 38. *pp.* 977–997, *Sept.* 1, 1931.—The distribution of mercury atoms scattered from NaCl, KCl, KBr and KI has been studied by means of an ionisation gauge as a function of the angle of incidence and temperatures of scatterer and incident beam. The following facts are observed for the first three crystals: (1) There is a directed beam whose deviation from a specular position increases at smaller glancing angles. (2) The angle between the crystal surface and the direction of maximum intensity in the directed beam becomes less for lower crystal temperature and higher beam temperatures. (3) The relative number of atoms scattered at random increases with decrease in crystal temperature. (4) The directed beam becomes more sharply defined at lower crystal temperatures. Within the limits of error of the present experiments no discernible change is produced by rotation of the scattering crystal about an axis perpendicular to the plane of its face. The above facts are shown to be, qualitatively at least, consistent with a space-grating theory of reflection. In the case of KI the scattering was entirely random, *i.e.* according to the cosine law. This is also true for scattering by glass.

AUTHORS.

337. Electron Terms of the Hydrogen Molecule. E. A. Hylleraas. *Zeits. f. Physik*, 71. 11–12. *pp.* 739–763, *Sept.* 26, 1931.—Shows how the eigenvalues and eigenfunctions of the hydrogen molecular ion can be obtained by a comparatively simple method. The eigenfunctions of the molecule are built up from these solutions of the two-centre problem in first approximation, and by means of a calculation of the perturbation the energy of the molecule is obtained. If one calculates with the external electron, using " half " nuclear charges, the perturbation will be very small in the excited states. It is thus unnecessary to carry out the troublesome perturbation calculations in full detail, and only certain principal terms of the eigenfunctions need be considered. Certain small correction terms in the further calculation can be omitted, and the excited electron terms can thus be obtained with considerable accuracy, at least for such nuclear distances as exist in the molecule. The ground state requires a special investigation, since the perturbation energy is then considerable.

H. N. A.

338. Quantised Rotation of Atoms. E. L. Palumbo. *Univ. Nac. La Plata, Estudio Ciencias,* 5. *No.* 93. *pp.* 399–437, *Sept.*, 1931.—Loyarte's hypothesis of the quantised rotation of atoms [see Abstracts 2191 and 2431 (1930)], and especially of the atoms of mercury, thallium, and potassium, is shown to be without foundation, since the agreement upon which it is based is merely fortuitous. Moreover, the so-called addition-subtraction potential of 1·4 volts for mercury, and the constants 7571·8 and 27441 for thallium and potassium, respectively, have no physical significance. Loyarte's measurements of the critical potential of mercury are regarded as valueless. [See also following Abstract.]

H. F. G.

339. Addition-Subtraction Potential of 1·4 Volts in the Mercury Atom. R. G. Loyarte. *Univ. Nac. La Plata, Estudio Ciencias,* 5. *No.* 93. *pp.* 439–475, *Sept.*, 1931.—A reply to Palumbo [see preceding Abstract]. It is shown that the existence of an addition potential for mercury of 1·4 volts may be deduced also from observations later than those of the author, and that the other potentials below 4·66 volts $(1s - 2p_3)$ are not simple, and may be obtained arithmetically by employing the potential of 1·4 volts. The physical significance of the calculated potentials is demonstrated by the facts, *inter alia*, that they serve to explain Messenger's results relating to the number of metastable atoms which appear at each potential above 4·66 volts, and yield values of the wave-lengths of spectral lines which accord exactly with those observed. Palumbo's criticisms are discussed in detail.

H. F. G.

340. Quantised Singularities in the Electromagnetic Field. P. A. M. Dirac. *Roy. Soc., Proc.* 133. *pp.* 60–72, *Sept.* 1, 1931.—This paper puts forward a new idea concerning negative energies of electrons, and is concerned essentially with the reason for the existence of an elementary electric charge, which, by experiment, is known to exist. The theory when worked out gives a connection between the elementary electric charge and the elementary magnetic pole; it shows a symmetry between electricity and magnetism quite foreign to current views, but does not, however, give a theoretical value for e, the elementary electric charge. The paper also shows that quantum mechanics really does not preclude the existence of isolated magnetic poles, and discusses why these poles are not observed.

H. L. B.

341. Generalised Spherical Harmonics and the Wave Functions of an Electron in the Field of a Magnetic Pole. I. Tamm. *Zeits. f. Physik,* 71. 3–4. *pp.* 141–150, *Aug.* 15, 1931.—Dirac has recently obtained the wave-equation of an electron in the field of an isolated magnetic pole [see preceding Abstract]. The author calls the proper functions of this equation "generalised spherical harmonics," and discusses their properties mathematically.

N. D.

342. Duality and Determinism (Law of Causality). E. Gaviola. *Univ. Nac. La Plata, Estudio Ciencias,* 5. *No.* 93. *pp.* 243–275, *Sept.*, 1931. —There is no need to deny the possibility of a causal space-time description of experience; there is not only one such possibility, but actually two of them; and this superabundance of possibilities of description is the very reason why some relations can have only statistical validity. There are many physical phenomena which can be described in two ways, using either waves or corpuscles. The two systems by no means complement one another; they exclude each other, and every attempt to superpose the two descriptions leads to breaks in the laws of conservation of energy and momentum. In a wave-description the law of causality is maintained without restriction; in a corpuscle-description it is restricted only by Heisenberg and Bohr's indeterminism or by the impossibility of determining all of the initial conditions of a physical aggregate beyond a certain degree of accuracy. Certain phenomena, such as interference, can as yet be satisfactorily described only from one point of view. The magnitudes calculated in one system can have only statistical value in the other. The study leads to interesting conclusions in regard to Planck's constant h; shows that there are no stationary states in a wave-description, the sense of the relation $E = h\nu$, the identity between resonance radiation and regular reflection, and the need of renouncing the indivisibility of the electron from the wave point of view. A. D.

343. Properties of Wave Tensors. A. Eddington. *Roy. Soc., Proc.* **133.** *pp.* **311–324,** *Sept.* **1, 1931.**—A simplification and systematisation of the author's earlier work on the ψ-tensor calculus is given, and a number of new results are deduced. The author proposes the question: If we impose the condition that a wave-tensor is the product of two ψ-vectors, what is the corresponding restriction on the physical tensors equivalent to it? His answer is that whatever is described by two ψ-vectors, ψ, ψ^*, can equivalently be described by two space vectors of equal length at right angles to one another. One of these is the momentum vector; the other (generally ignored in current investigations) presumably represents positional relations (coordinate or distance), or may perhaps rather be regarded as the source of positional relations, which can only become explicit in more complicated developments involving many particles. The ordinary wave equation for one particle is obtained as an *identity*. The paper deals at some length with the question why the complete five-dimensional relativity admitted in the analytical formulæ, and believed to hold good in general dynamic theory, is cut down to four dimensions in applications to practical problems in an actual universe. H. L. B.

344. Wave Statistics. K. C. Kar. *Indian Phys. Math. J.* **2.** *pp.* **15–20,** *Sept.,* **1931.** *In English.*—In previous papers [see Abstract 2180 (1931)] the author and others have developed the statistical theory of the waves filling the p and q spaces for an assembly of molecules or electrons. Of these statistical or group waves, the X_1-waves travel through the q space, while the X_2-waves exist only in the momenta space as radiation. The X_1-waves are the electrons or molecules of classical theory. The X_2-waves have always a projection in the q-space, which is radiation or X_3-waves. It is now shown (1) that X_3-waves may be non-electromagnetic in character, and of wave-length between the shortest wireless wave and the longest infra-red heat wave, (2) that the average X_1- or matter-wave is an acoustic wave, and (3) that by using the classical value of frequency one does not derive discrete values of the energy of the linear oscillator, the rotator or the Bohr electron. A correction for the phase density due to the random motion imparted to the electron is deduced, and the laws of collision between X-waves are discussed. J. S. G. T.

345. Electron Cloud. S. C. Kar. *Indian Phys. Math., J.* 2. *pp.* 21–24, *Sept.,* 1931.—It is considered whether, according to classical ideas, a negative electron cannot encamp in the form of a cloud about a positive nucleus regarded as a point charge, the negative charge being distributed over the whole of space with a definite energy distribution. From a classical expression for the energy, in terms of the potential, and assuming spherical symmetry, an expression for the distribution function is found. It is concluded that under certain conditions, an electron such as the above can exist. Contrary to experience and Schrödinger mechanics, there is an equilibrium configuration corresponding to every possible negative value of the energy. Also the stability of the system is not discussed. N. D.

346. Dynamic (Quantum) Extension of the Principle of Relativity. H. Mandel. *Zeits. f. Physik,* 71. 1–2. *pp.* 26–29, *Aug.* 4, 1931.—The facts of the Dirac-Jordan transformation theory are so formulated, that the analogy between the interpretation of the kinematical conditions of a measurement according to the theory of relativity, and the interpretation of dynamical conditions in quantum mechanics, can be clearly expressed. N. D.

347. Definition of Distance in Curved Space, and Displacement of Spectral Lines of Distant Sources. E. T. Whittaker. *Roy. Soc., Proc.* 133. *pp.* 93–105, *Sept.* 1, 1931.—Discordances in conclusions, by different investigators, relating to the displacement of lines in the spectrum of a distant star may be traced to ambiguities in the significance of the terms " time," " spatial distance " and " velocity." The author defines " spatial distance " in accordance with the principle by which astronomers actually calculate the " distance " of very remote objects, such as the spiral nebulæ. The principle is this: first, the absolute brightness of the " star " is determined and compared with its apparent brightness. The *distance* of the star is then defined as being proportional to the square root of absolute/apparent brightness. Adopting this principle into differential geometry, distance, so defined, is an invariant. It involves, however, not only the positions of the star and the observer, but also the motion of the observer, as is recognised in the theory of restricted relativity. The conception of " spatial distance " developed is totally distinct from the conception of interval, *ds*, and it is suggested that in discussions on the relation which the displacement of spectral lines of remote objects bears to the distance, and in discussions on " expanding universes," it is desirable that the term "distance" should be used in the sense here defined. J. S. G. T.

348. Doppler Effect in de Sitter's Universe. J. Chazy. *Bull. Astronomique,* 6. 9. *pp.* 341–354, 1930.—The author criticises a formula obtained by Silberstein for the Doppler effect for distant objects in de Sitter's universe, and replaces it by a formula of his own. From this formula it is possible to derive simply the result that the total Doppler effect is the sum of the true Doppler effect due to the velocity of the source and that due to the distance-effect. G. C. McV.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

349. Radio Tracking of Meteorological Balloons. W. R. Blair and H. M. Lewis. *I.R.E., Proc.* 19. *pp.* 1531–1560, *Sept.*, 1931.—In a preliminary note the author reviews early methods used to find the upper air wind speed and direction in foggy or cloudy weather when a balloon becomes invisible from the ground. Details are then given of the form of equipment developed and tested to transmit radio signals. The transmitter finally used weighs only about 1 lb., and consists of a buzzer transformer connected to a small 4½-volt battery and triode valve with a suspended antenna. A preliminary adjustment is made before release to get a suitable note from the buzzer and suitable current from the battery. The design of the direction finder is discussed in detail for eight different circuits, and a diagram of the circuit, and a photographic plate, illustrate the form of portable receiver finally adopted. Readings can be obtained to 0°·5 for a balloon at a distance of five miles, the balloon being inflated to rise at a predetermined rate. The errors arising from the nearness of metal structures, and telegraph or power lines, and the swinging of the antenna and consequent rotation of the plane of polarisation of the waves are discussed. The apparatus is later to be developed to give upper air temperatures. R. S. R.

350. Alt Electric Light Spectral Actinometer System. H. Goldschmidt and R. Fleischer. *Zeits. f. Instrumentenk.* 51. *pp.* 417–426, Aug., 1931.—The apparatus consists of a spectral tube containing a grating mounted on quartz and so arranged that one spectrum falls on a photoelectric cell. By means of a slit seven regions in the range 300–720 $m\mu$ are allowed to fall on the cell. Slits are arranged to reduce the scattered light and to increase the purity of the spectrum. The cell is highly evacuated, and has K deposited on a base of Ag or Cu, and it must be constant, sensitive to the red, non-selective, or only weakly so, in the red, and free from after action. Moving charges which could disturb the field are not present. Particulars are given of the electrometer and its connections. In measuring the electronic current in the cell three processes are available, (1) discharge, (2) charge, and (3) discharge to earth through a high resistance. Of these, (1) gives a high sensitivity and great accuracy, while (3) possesses the simplest measuring procedure. In a series of measurements the shift of the maximum intensity to the red with decreasing solar intensity and the increase of amplitude in the daily oscillation with decreasing wave-length are shown. R. S. R.

351. Absorption and Ionising Effect of Monochromatic Radiation in an Atmosphere on a Rotating Earth. Part II. S. Chapman. *Phys. Soc., Proc.* 43. *pp.* 483–501, *Sept.*, 1931.—The absorption of radiation from the sun in an atmosphere varying exponentially with the height is considered, as in a former paper [see Abstract 1819 (1931)]; but here the earth's curvature, and that of the level layers in the atmosphere, is taken into account. The values of this absorption as previously calculated are valid so long as the sun's zenith distance does not exceed 75°, but for greater zenith distances the necessary corrections are of importance. It is shown that the absorption, and resulting ionisation or dissociation of the

air, should begin to increase before ground sunrise, the interval varying from about ten minutes at the equator to about an hour at 60° latitude.
AUTHOR.

352. Geophysical Stereograms. J. Bartels. *Terr. Mag.* 36. *pp.* 187–199, *Sept.*, 1931.—The use of stereograms for the representation of geophysical data is discussed. Formulæ and practical rules for constructing stereograms and anaglyphs (stereoscopic drawings in two colours) are given. Ten sample stereograms, based on unpublished material, are reproduced and discussed. With the exception of No. 1, which illustrates the principle of construction, and No. 10, which shows upper-air currents at Apia, Samoa, the stereograms bear on magnetic phenomena, namely: Nos. 2 to 5—Diurnal and annual magnetic variation at Watheroo (Australia); No. 6—Changes during part of a magnetic storm; No. 7—Differences of the mean magnetic vector on disturbed and quiet days at Potsdam, 1915 to 1928; No. 8—World-chart of secular variation for 1925; No. 9—Globe showing magnetic axes of the earth, and distribution of magnetic observatories. While some of the stereograms present only new illustrations of well-known facts, the discussions which accompany Nos. 4 to 8 suggest some novel points.
AUTHOR.

353. Luminous Phenomena Accompanying Earthquakes. T. Terada. *Tokyo Univ. Earthquake Research Inst., Bull.* 9. *pp.* 225–255, *Sept.*, 1931. *In English.*—The author reviews the data available from old records regarding this subject, and in particular the large amount for the Idu earthquake of Nov. 26, 1930. The types classified are (1) indefinite instantaneous illumination such as lightning, sprinkles and streamers; (2) a well-defined and mobile mass such as a fireball, fire-column, beam of fire or luminous column; (3) bright flame and emanation from a flame, spark or luminous vapour; and (4) phosphorescence of sky and clouds giving a diffuse light in the sky or a luminous cloud. Among possible causes for the phenomena are discussed thunderstorms, power-line sparking, triboluminescence, and also the large potential difference which may be created between the upper atmosphere above the epicentre and more distant regions, as a result of changes in the underground capillary water flow. No definite conclusions regarding the causes can be reached until more data of a reliable character are available.
R. S. R.

354. Movement of the Ground Due to Atmospheric Disturbance in a Sea Region. K. Sezawa and G. Nishimura. *Tokyo Univ. Earthquake Research Inst., Bull.* 9. *pp.* 291–309, *Sept.*, 1931. *In English.*—The author has studied the movement of the ground due to the disturbed sea in rough weather to find to what extent changes of air pressure and of the resulting waves influence microseisms in the neighbourhood of the sea. From a mathematical investigation it is found that four kinds of ground displacements occur due to the transmission of (1) shallow water waves, (2) Rayleigh waves, (3) distortional waves, and (4) dilatational waves. The velocity of transmission due to (1) equals that for the water waves, but for (2), (3) and (4) other velocities occur. The amplitude of the deformation of the solid body due to (1) and (2) $\propto 1/\sqrt{\text{epicentral distance}}$, and for (3) and (4) $\propto \sqrt{\text{epicentral distance}}$. The microseisms due to disturbed weather in another region are chiefly due to long water waves, including coastal breakers near the observing station, and not to seismic waves transmitted from the region of disturbed weather. The action of long water waves is relatively small compared with that of breakers. The amplitude of the ground due to a pulsatory disturbance of long period is less than that of a short period, even though the amplitude of the disturbing pressure is constant. The views agree with those of Gutenberg, but oppose those of Banerji. [See Abstracts **3954** (1930) and **3744** (1931).] R. S. R.

355. Seismograph for Measuring Acceleration. M. Ishimoto. *Tokyo Univ. Earthquake Research Inst., Bull.* 9. *pp.* 316–332, *Sept.*, 1931. *In French.*—The instrument previously described [see Abstract 3745 (1931)] is modified so that registration is mechanical. The pendulum has a vibration period of 0·15 sec., and to it is connected a train of three levers, with a damping device attached to the first, giving a total amplification of 213; the pen, of steel or tungsten, inscribes the record on smoked paper, a movement of 1 mm. corresponding to an acceleration of 1·23 gal. Constructional and mathematical details and examples of the records are given. C. A. S.

356. Surface Waves upon a Semi-Infinite Solid of Varying Elasticity. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 9. *pp.* 310–315, *Sept.*, 1931. *In English.*—Differential equations of motion are written for a semi-infinite solid in which displacements are subject to the conditions that the dilatation, and the displacement perpendicular to the free surface, are both zero, and the rigidity μ is a linear function of the depth z, *viz.*, $\mu = c(d + z)$. The solution, obtained by successive approximations, represents a surface wave, propagated with a velocity of $\sqrt{\frac{1}{2}\left\{1 - \frac{1}{24}(kd)^2\right\}} \cdot \sqrt{\frac{\mu_0}{\rho}}$, where $2\pi/k$ is the wave-length, μ_0 is the rigidity at the surface and ρ the density of the solid. The radial component of the wave-motion is rapidly damped out, while the transverse component continues. J. P. A.

357. Motion of Earth's Surface under Influence of a Heavy Moving Body. T. Inui, M. Kotani, and Z. Sakadi. *Phys. Math. Soc., Japan, Proc.* 13. *pp.* 223–252, *Sept.*, 1931.—The earth is assumed to be a semi-infinite elastic solid, the body to be in uniform rectilinear motion, velocity v, and to exert only normal pressure on the surface, such pressure being uniformly distributed in a circle of finite radius which tends to zero. If v is greater than the velocities of propagation of both dilatational and rotational waves, the displacement components are finite; if it lies between them no finite solution is obtainable; if less than both, only the vertical component is expressible in finite form. C. A. S.

358. Seasonal Variations in Adopted Clock Corrections. C. C. Smith. *Roy. Astron. Soc., Canada, J.* 25. *pp.* 313–318, *Sept.*, 1931.—The author reviews the advantages to be obtained if the probable errors of observatory clock corrections could be reduced to ± 0·01 sec. Small errors and others of a systematic or long-period nature occur to reduce this possibility. The prevalence of these errors has been tested by plotting the monthly means of residuals at Ottawa, and comparing them with the means of Paris, Washington, Hamburg, Greenwich and Tokyo over a period of several years. These curves show a decidedly annual variation with low spots (Ottawa clocks too slow) in February and August. The same effect is shown when other observatories are compared similarly. The amplitude of the variation is usually $< 0·05$ sec., but it differs for different observatories, and may not occur regularly in the time of any single observatory, although apparently doing so for Ottawa. A suggested procedure for further test is given. R. S. R.

359. Potsdam Eclipse Expedition to Sumatra, 1929. Part IV. Total Solar Eclipse of May 9, 1929. H. v. Klüber. *Zeits. f. Astrophysik*, 3. 2. *pp.* 142–162, *Aug.* 11, 1931.—In continuation of previous papers, results are here given of the photometric measurement of plates taken with the 8½ m. horizontal camera. Though specially intended for investigation of the Einstein effect, these plates provide excellent images of the corona, and from them an isophotometric diagram has been constructed, and the law of diminishing intensity of coronal light with increasing distance outwards from the sun has been deduced. It agrees well with results from the 3·4 m. astrographic instrument. M. A. E.

360. Potsdam Eclipse Expedition to Sumatra, 1929. Part V. Deflection of Light in the Sun's Gravitational Field. E. Freundlich, H. v. Klüber, and A. v. Brunn. *Zeits. f. Astrophysik*, 3. 3. *pp.* 171–198, *Sept.*, 15, 1931.—An 8·5 m. double camera with cœlostat was used to make four exposures in the neighbourhood of the sun, and three of a region about 25° away, during the eclipse, and again of the same regions about six months later; a collimator with a criss-cross grating at its focus threw an image of this also on the plates, as a check against distortion of the film and against certain possible optical defects. The various possible sources of error are discussed very thoroughly; some are especially important in view of the fact that the great majority of the eighteen stars used lay on the same side of the sun. There is clearly deflection of the light; if, however, the deflections are fitted to a hyperbolic curve, the extrapolation to the sun's radius gives a value there of 2″·24, instead of the theoretical 1″·75. The previous measurements obtained by the Greenwich expedition of 1919 and the Lick measurement of 1922 are re-examined; the former are found to indicate that the value is probably larger than the theoretical one, and the latter, when a correction is applied that was originally omitted, agrees well with the present results. R. d'E. A.

361. Potsdam Eclipse Expedition to Sumatra, 1929. Part VI. Intensity Distribution in Spectrum of Inner Corona. W. Grotrian. *Zeits. f. Astrophysik*, 3. 3. *pp.* 199–226, *Sept.* 15, 1931.—The continuous spectrum of the corona compared with the average spectrum of the sun's disc confirmed the results as to the intensity distribution in the former already given by Ludendorff. In addition, indications were obtained from the intensity curves for the region $\lambda = 5100$ to 4700, that this region contained an excess of short wave-lengths. Also the absorption in the H and K lines reduces the intensity in the spectrum in the corona. The general deduction from the results of the observations is that the light of the corona is sunlight scattered by electrons, but it seems necessary to assume that, in addition, the corona radiates on its own account to some extent. G. C. McV.

362. Coronal Brightness at Total Solar Eclipses of May 9, 1929, and October 21, 1930. H. T. Stetson. W. Arnold, and J. Johnson. *Astrophys. J.* 74. *pp.* 122–130, *Sept.*, 1931.—The Macbeth illuminometer, as previously used at the Sumatra eclipse of 1926, and described elsewhere, has been specially adapted for eclipse work by certain improvements in design. Results in the measured coronal brightness with the improved apparatus were obtained at the May 9 eclipse of 1929 at

Alor Star, Malaya, and that of October 21, 1930, at the island of Niuafou. Light-curves of the entire eclipse are presented, giving the total illumination at mid-minimum at the eclipse of 1929 as 0·15 foot candle, and for the eclipse of October 21, 1930, as 0·378 foot candle. The necessity for ultimately correcting all photometric values for the duration of the eclipse is pointed out. It is believed that evidence remains, however, for the increased brightness of the corona at times of sun-spot maximum. The time of mid-totality is determined from the photometric light-curve with a probable uncertainty of a very few seconds. AUTHORS.

363. Solar Motion Graph. J. A. Pearce and S. N. Hill. *Dominion Astrophys. Obs., Victoria, Publ.* 6. 4. *pp.* 1–2, 1931.—A graph has been constructed whereby the components of the solar motion of 20 km./sec. towards the apex $\alpha_0 = 271°$, $\delta_0 = +28°$, may be determined by simply plotting the arguments α and δ of the star. The result is given with a precision of $\pm 0 \cdot 1$ km./sec. AUTHORS.

364. Duration of the Actual Solar Period. H. Mémery. *Comptes Rendus,* 193. *pp.* 483–485, *Sept.,* 28, 1931.—Since the mean period of solar activity is 11·1 years, nine such periods make up a century. The author gives tables of maxima and of minima in parallel columns for the seventh, eighteenth, nineteenth and twentieth centuries, and points out the discrepancies in the maxima and minima at the end of the eighteenth century. He intimates that for the most part hot seasons coincide with maximum sunspot activity, and cold seasons with minimum. From the frequency of spots in 1928–1931, he predicts the next minimum as in 1933 or 1934 at latest; and since the successive solar periods are not similar in duration or intensity, in spite of the general secular correspondence, suggests the presence of another period. A. S. D. M.

365. Influence of Collisions on Formation of Fraunhofer Lines. A. Pannekoek. *K. Akad. Amsterdam, Proc.* 34. 6. *pp.* 755–763, 1931.—The abundance of the losses of energy by collisions between two atoms in an absorbing atmosphere can be calculated from the intensity distribution in an absorption line. This distribution cannot be easily or accurately measured, and it is better to determine instead the amount of light of the continuous spectrum which is cut off by the absorption line; this amount can be expressed as an equivalent width in Å.U. From the equivalent widths of certain lines and line groups the concentration of atoms in various states can be ascertained. From such measurements of Minnaert and Mulders on the Fraunhofer lines a value of the damping constant ν' is found which is nine times as large as the classical value. If this high value of ν' were due to the influence of collisions it would be larger for the dwarf stars than for the giant stars, since the dilute atmospheres of the latter must give fewer collisions. The author determines the equivalent widths of some absorption lines of TiII, FeII and CrII in the spectrum of the supergiant α Cygni. It is found that the value of ν' for this star is about nineteen times greater than the classical value. Comparing this value with the value of Minnaert and Mulders for the sun, it follows that collisions, compared with spontaneous processes, play no perceptible rôle in the energy interchanges of the atoms in the solar atmosphere. J. E. K.

366. Application of Kinematograph to Celestial Photography. F. C. and R. C. McMath and H. S. Hulbert. *Am. Phil. Soc., Proc.* 70. 4. *pp.* 371–379, 1931.—The telescope used is a 10½-in. Pyrex Cassegrain reflector; the camera a standard Eastman Ciné Kodak for 16 mm. films. The driving in R.A. is by Telechron motors, using 60-cycle current, and by gears with a ratio of 365 to 366, sidereal rate is closely obtained. The registration must be very exact. For Moon photography the guiding problem is difficult because of the rapid motion (real and apparent) in declination and R.A., and because of its changing parallax and refraction; the method of changing the clock rate is secured by a special frequency-changer, which makes lunar guiding in R.A. as in declination. For the moon a table has been made giving the composite effect of declination, parallax and refractor changes with the hour angle. A fundamental difficulty in the problem is the securing of a satisfactory relation between length of exposure and the number of feet of film necessary to give adequate projection time on the screen. The camera drive device is described and illustrated. Results are given of films taken of the moon (the Crater Albategnius) and Jupiter's disc, and with his satellites I, II and IV.

A. S. D. M.

367. Extinction of Light in Jupiter's Atmosphere. D. J. Eropkin. *Zeits. f. Astrophysik,* 3. 3. *pp.* 163–170, *Sept.* 15, 1931.—The absorption of light in the atmosphere of Jupiter is determined by the rate of darkening of the disc of a satellite during an eclipse. The method is photographic. The result is that, for light capable of affecting photographic plates, the light due to reflection from the atmosphere of Jupiter forms 9% of the light coming from the whole apparent disc of the planet.

G. C. McV.

368. Photographs of the Milky Way in Cygnus and Cepheus. F. E. Ross. *Astrophys. J.* 74. *pp.* 85–90, *Sept.,* 1931.—Reproductions of two negatives of the Milky Way in Cygnus and Cepheus, each covering a wide field, and of a negative of the veiled nebulæ in Cygnus, taken on a larger scale, are given. Various problems connected with photographing the sky with wide-angle lenses are considered. The characteristics of the lens are pointed out, and a simple method of curving the photographic plate, in order to improve the field, is given. A very simple and efficient backing for the plates is described. The question of the proper developer to bring out the faint extended nebulæ on the negative is taken up. Returning to the reproductions, an error sometimes made in judging relative magnitudes of nebulæ or stars from prints or reproductions is pointed out, and application made to stellar photometry.

AUTHOR.

369. Effect of Space Absorption on the Calculated Distribution of Stars in Space. F. H. Seares. *Mt. Wilson Observat. Contrib. No.* 428. *Astrophys. J.* 74. *pp.* 91–100, *Sept.,* 1931.—The apparent space-distribution of all stars as a function of distance, which can be obtained from star-counts of apparent magnitudes, with the aid of an assumed distribution of absolute magnitudes, differs from the true space-distribution if absorption is present. A relation is given between the absorption coefficient and the apparent and true distributions, from which the true distribution can be found if the absorption (as a function of the distance) is known. It is pointed out that if the absorption is selective, and if the type of selectivity is known, the dependence of the absorption on distance can also be found directly, by a comparison of the results obtained from visual and photographic counts; this process cannot yet be carried out for lack of data. It is shown that absorption probably does not distort the assumed distribution of absolute magnitudes, which is obtained from counts of nearby stars; this distribution is taken to be the same at all distances. The formulæ are applied to calculate the true distributions for various assumed absorption-coefficients; if the coefficient is constant at about Trumpler's figure of 0·67 mag. per 1000 parsecs, or if it starts somewhat below this figure and rises slightly with distance, the distribution in the direction of the galactic centre turns out to vary in a plausible manner; the distribution in the opposite direction cannot, however, decrease with increasing distance unless the absorption also decreases. Thus the absorption appears to vary differently in different directions. R. d'E. A.

370. Spectroscopic Orbit of RT Lacertae. A. H. Joy. *Mt. Wilson Observat. Contrib. No.* 429. *Astrophys. J.* 74. *pp.* 101–104, *Sept.*, 1931.—Twenty-three spectrograms taken with the 100-inch reflector, on fourteen of which the spectra of both stars are visible, allow a determination of the spectroscopic orbit. On the average 8·5 lines of the primary star (K1), and 12·0 of the secondary (G9) could be used per plate; the secondary is the brighter, which is very unusual. Combining the results with a solution for stars darkened at the limb, the full set of elements is obtained; the absolute magnitudes are calculated from assumed surface-temperatures of 4500° and 4200°, leading to a parallax more than five times smaller than van Maanen's figure. The stars are intermediate between giants and dwarfs, and though it is impossible to fit both of them to the mass-luminosity relation the individual discrepancies are not excessive. R. d'E. A.

371. Spectroscopic Orbit of Boss 523. W. E. Harper. *Dominion Astrophys. Obs. Victoria, Publ.* 6. 1. *pp.* 1–10, 1931.—This star was discovered to be a spectroscopic binary by the author in 1922. Since that time to the present forty-two measurable spectrograms have been secured. In 1927, when thirty had been secured, preliminary work suggested that in addition to the main period of 93·50 days there was a longer one of about two years with a semi-amplitude of velocity variation of nearly 10 km./sec. for this larger orbit. Publication was withheld, and twelve additional plates have since been secured and the whole series measured anew on the micrometer engine. The trend of the residuals seems peculiar, but as one year would suit the residuals almost equally as well as the two-year period previously entertained, it is preferred to consider them wholly accidental until some further investigation has been made. The eccentricity is 0·445, $\omega = 100°\cdot 95$, $\gamma = + 25\cdot 75$ km./sec., $K = 19\cdot 43$ km./sec. and T = J.D. 2, 423 389·995. AUTHOR.

372. Orbit of H.D. 185936. S. N. Hill. *Dominion Astrophys. Obs. Victoria, Publ.* 6. 2. *pp.* 11–15, 1931.—Seventy spectra are the basis of the spectroscopic orbit of H.D. 185936, resulting in a period of 2·4968 days, $\gamma - 14\cdot 2 \pm 1\cdot 0$ km., semi-amplitude $47\cdot 3 \pm 1\cdot 3$ km., eccentricity $0\cdot 056 \pm 0\cdot 027$. The probable error of a plate is ± 5·3 km. per sec. AUTHOR.

373. Distribution of Absolute Magnitudes among F and G Stars from Observed Motions. G. Strömberg. *Mt. Wilson Observat., Contrib. No.* 430. *Astrophys. J.* 74. *pp.* 110–121, *Sept.*, 1931.—The distribution of absolute magnitude among F and G stars brighter than apparent magnitude 6·0 has been determined from the distribution of parallactic and peculiar reduced proper motions, and of radial velocities by methods previously described [see Abstract 1849 (1931)]. The number of proper-motion stars in the F and G groups is 622 and 601 respectively; of radial-velocity stars, 573 and 707 respectively. The distributions of absolute magnitudes are shown in a table and figures. Among stars of types F0–F9 the distribution shows three distinct maxima: supergiants between $M = -5$ and $-2\cdot0$; normal giants between $M = -0\cdot2$ and $+2\cdot2$; and dwarfs or faint giants between $M = +2\cdot2$ and $+5\cdot0$. The relative proportion of stars in the three groups is 9, 45, and 46 %. The distribution for the spectral interval G0–G9 reveals three distinct maxima: supergiants between $M = -5$ and $-1\cdot5$; normal giants between $M = -0\cdot5$ and $+1\cdot5$; and a third group between $M = +1\cdot5$ and $+5\cdot5$. The relative proportion of stars in the three groups is 19, 49, and 32 %. The third group consists possibly of faint giants with a maximum at $+3\cdot0$ and of dwarfs at $+4\cdot0$, in a relative proportion of 23 and 9 %. Among both the F and the G stars there is a complete absence of stars having an absolute magnitude near $M = -1\cdot0$. R. d'E. A.

374. Potsdam Scale of Visual Magnitudes. F. H. Seares. *Mt. Wilson Observat., Contrib. No.* 431. *Astrophys. J.* 74. *pp.* 131–144, *Sept.*, 1931.—Potsdam measures of the Polar Sequence.—Visual magnitudes of thirty-six stars of the Polar Sequence brighter than about 12·3 occur in the following Potsdam catalogues: PD, 11 stars; PDP (*Potsdam Polar Catalogue*, by Hassenstein), 22 stars; PDP supplement (PPS), 26 stars (Table III). Comparison with International Scale.—About one hundred stars appearing in both the PD and the PDP and numerous measures of the same star by the different observers afford data for the reduction to a homogeneous system of the three overlapping series of PS observations. The colour system adopted for this reduction, which is that of Müller for the years 1909–1916, agrees with the Mount Wilson photovisual system. The reductions to the international zero-point for the three series are consistent; the mean scale differences MW Pv—P Vis are small and show no important systematic change within the interval 2–12 magnitudes. Relation of the PD and PDP to the MW Pv scale.—The discussion of the PS stars leads finally to the relations between the scales of the PD and PDP and the MW Pv scale. These formulæ are subject to certain modifications and restrictions which are explained in the text. AUTHOR.

375. Stability of the Atmosphere of a Rotating Star. R. Gunn. *Phys. Rev.* 38. *pp.* 1052–1056, *Sept.* 1, 1931.—It is shown that electromagnetic forces acting on the gaseous ions of a rotating magnetised star can account for its atmospheric stability even when the star proper approaches a condition of rotational instability. Milne's theory of the chromospheric stability is shown to be inconsistent with observations if electromagnetic forces are taken into account. Because the ions are entrapped by the magnetic field the loss of atmosphere by a rapidly rotating star is small, and therefore its angular velocity may increase until rotational instability of the entire mass sets in. The considerations of the paper lend considerable theoretical support to the fission theory of multiple stars. AUTHOR.

376. Physical Interpretation of Colour-Excess in Early-Type Stars. E. Öpik. *Harvard Coll. Obs., Circ. No.* 359. [17 *pp.*], *March* 13, 1931.—From a table of the mean colour indices and their probable deviation for stars of types Fo to O, the author notes that there is unsteadiness in colour and depression in the average colour-indices for stars earlier than B3. Gerasimovič attributes this to "superexcitation," not to selective absorption, but Öpik shows that the arguments against this latter hypothesis are invalid; in the case of ζ Persei it is admitted that continuous hydrogen absorption causes the "ultra-violet appendage." Early-type colour-excess may be due to the star's atmosphere (stellar), or to an absorbing medium in space (interstellar). The physical cause may be selective scattering, change of photospheric opacity with wave-length, or true photospheric deviation from black-body radiation (Gerasimovič suggests subatomic processes below the surface). Selective scattering may be stellar or interstellar, and by small (Rayleigh) or by all sizes (0 to ∞) of particles (obeying the law of size distribution found in meteors). Equations for stellar and interstellar Rayleigh scattering are given and yield different effective temperatures. Interstellar scattering for all sizes exhibits simple obstruction, independent of wave-length, for very large particles, and the Rayleigh for very small, but for particles comparable with λ the scattering is uneven in different directions, thus varying unlike radiation pressure. He concludes that the meteoric distribution of particles gives a change in effective temperature independent of wavelength, and the same for colour and radiation temperatures—a black body distribution lowered according to distance. There may be a real "ultra-violet appendage" due to scattering by interstellar dust, with a "meteoric" distribution of the particles. This is the most probable explanation of colour-excess, but the author discusses three other hypotheses. A. S. D. M.

377. Luminosity of Planetary Nebulae and Stellar Temperatures. H. Zanstra. *Dominion Astrophys. Obs. Victoria, Publ.* 6. 15. *pp.* 209–260, 1931.—The author makes the assumptions that diffuse and planetary nebulæ are excited to luminosity by far ultra-violet starlight, which light produces photoelectrons, and that luminosity is due to one or both of two mechanisms: (1) recombination, a main source of the spectra of H, He_I, He_{II}, etc.; and (2) electron-excitation by photoelectrons prior to recombination, a main source of the resonance "nebulium" lines. Further, he assumes that: spectral distribution of energy of the exciting star is that of a black body, even far into the ultra-violet; the nebula is in a stationary state; the absorption of ultra-violet starlight is practically complete (particularly hydrogen); recombinations on the first and second levels, producing Ly_c and Ba_c, are neglected with respect to those on higher levels; much free electron energy before recombination is given up in the excitation of the nebulium resonance lines, and much of this is in N_1 and N_2. The results according to the two mechanisms are as follows for the nebulæ, N.G.C. 6543: 39,000° (H), 37,000° (Neb); N.G.C. 6572: 40,000° (H), 35,000°–42,000° (He_I), 38,000° (Neb). The good agreement between these results is taken as evidence that the assumptions are justified fairly well. A formula is found for an approximate temperature determination from the difference in magnitude of star and nebula. N.G.C. 6445 and N.G.C. 1952 give minimum temperatures of 140,000° and 105,000° respectively, and it is concluded that the mechanism of luminosity discussed requires a stellar temperature as high as 100,000° for some planetaries, and this accords with Bowen's conclusions based on the relative intensities of nebular spectral lines as given by Wright. The author discusses the difficulties in the theory raised by Z Andromedæ, and N.G.C. 7000, with its associated star α Cygni. A. S. D. M.

LIGHT.

378. Light Sources for Absorption Measurements. W. M. Cohn and C. Andresen-Kraft. *Zeits. f. techn. Physik*, 12. 9. *pp.* 428–433, 1931.—Describes three different types of light sources for use in determining the spectral absorption curves of media in the ultra-violet. The hydrogen tube gives a continuous spectrum between 289 and 480 mμ, and the over-run tungsten lamp in a uviol glass bulb gives radiation to the same limit on the short-wave side. A lamp in which a thorium disc is bombarded with a kathode stream gives a continuous spectrum between 220 and 600 mμ. The great advantage of this lamp over the tungsten lamp is that the longer wave-lengths are almost entirely absent, so that the specimen is not heated and consequently no change of the transmission curve is caused by this effect. J. W. T. W.

379. Absorption of Light in Simple Crystals. R. Hilsch and R. W. Pohl. *Phys. Zeits.* 32, *pp.* 734–736, *Sept.* 15, 1931.—The absorption of light in the two bands of KBr at 173 and 188 mμ produces a photochemical reaction product having a band in the visible, although the concentration of the " colour centres " is extremely small. The first absorption process, the passage of an electron from an anion to the next kation, cannot be detected electrically, but the second process sets free electrons, tending to reverse the process. These free electrons can be detected as a current, and a simple demonstration experiment, in which a KBr crystal is illuminated successively with ultra-violet and red light, is described. The quantity involved is of the order of 10^{-11} ampere-sec., and can thus easily be measured with an electrometer. If the crystal is illuminated with white light, both processes occur together, and this is applied to measurement of the very feeble absorption in other spectral regions. The experiments are discussed in relation to photography, and the properties of selenium crystals. C. B. A.

380. Continuous Absorption in Lithium and Sodium Vapour. B. Trumpy. *Zeits. f. Physik*, 71. 11–12. *pp.* 720–734, *Sept.* 26, 1931.—Gives the results of the measurements of the limiting continuum of the lithium main series. df/dE seems to decrease somewhat with increasing E, but the percentage does not exceed 5, and is in general undiscoverable. For sodium, the df/dE curve sinks more rapidly with the distance from the limit than for lithium. E. E. F. d'A.

381. Distribution of Energy in Total Reflection. F. Noether. *Ann. d. Physik*, 11. 2. *pp.* 141–146, *Sept.* 11, 1931.—A simplified mathematical investigation of the periodic distribution of energy in a totally reflected light beam. C. B. A.

382. Absolute Refractive Indices in Geometrical Optics. T. Smith. *Optical Soc., Trans.* 32. 1. *pp.* 37–38, 1930–1931.—Expressions are found for the computation of a system of fundamental coefficients for optical instruments which involve relative refractive indices only. The system is less convenient for numerical work than those now in use. The convention which assigns absolute values to the indices of materials is thus distinctly useful though of no physical significance. AUTHOR.

383. Refraction and Dispersion of Gaseous Pentane and Chloroform. H. Lowery and T. S. Hartley. *Phys. Soc., Proc.* **43.** *pp.* 559–560, *Sept.*, 1931.—The refractive index of gaseous *n*-pentane is found to be 1·001683 for the green mercury line, λ5461, the result being expressed in relation to the density of the gas. The dispersion over the range λ4358–λ6708 is represented by the Sellmeier equation: $(\mu - 1) = 14{\cdot}605 \times 10^{27}/(8978{\cdot}4 \times 10^{27} - \nu^2)$, where ν is the frequency of the incident light. Revised values for gaseous chloroform are: $\mu = 1{\cdot}001448$ for λ5461 and $(\mu - 1) = 15{\cdot}391 \times 10^{27}/(10933 \times 10^{27} - \nu^2)$. AUTHORS.

384. Refraction and Dispersion of Gaseous Ethyl Bromide. H. Lowery and J. K. Elliot. *Phys. Soc., Proc.* **43.** *pp.* 562–563, *Sept.* 1, 1931.—The refractive index of gaseous ethyl bromide in relation to density is found to be 1·001261 for the green mercury line, λ5461. The Sellmeier formula representing the dispersion over the range λ4358–λ6708 is $(\mu - 1) = 12{\cdot}407 \times 10^{27}/(10138 \times 10^{27} - \nu^2)$, ν being the frequency of the incident light. AUTHORS.

385. Refraction and Dispersion of Some Gaseous Compounds. H. Lowery. *Roy. Soc., Proc.* **133.** *pp.* 188–207, *Sept.* 1, 1931.—Results are given of measurements made by the author on the refraction and dispersion in the gaseous state of the substances on the following list. Two methods of measurement were employed and the general aim of the work was to render the recorded data on refraction complete for well-defined groups of compounds. The results are given in the following table:

Substance.	$(\mu - 1)_d$ for λ5461	$C \times 10^{-27}$	$\nu_0^2 \times 10^{-27}$
Silicon tetrachloride ..	0·001969	17·213	9044·3
Silicon tetrabromide ..	0·002725	12·940	5050·1
Boron trichloride	0·001404	9·5829	7127·5
Boron tribromide	0·002012	12·247	6388·7
Phosgene	0·001149	9·2574	8358·0
Acetone	0·001096	15·089	14069·0
Ethyl ether	0·001509	21·575	14595·0
Acetylene	0·0005936	3·824	6744·0
Ethylene	0·0007192	5·3564	7749·7
Ethane	0·0007648	8·4851	11396·0
Methyl chloride	0·0007804	5·8524	7801·0
Methylene chloride ..	0·001112	9·1881	8565·6
Methylene bromide ..	0·001435	12·215	8814·1

In this table the second column contains the values of the refractivities for λ5461 determined in relation to the densities of the substances; the third and fourth columns show the values of C and of ν_0^2 in the Sellmeier formula: $(\mu - 1)_d = C/(\nu_0^2 - \nu^2)$. J. J. S.

386. Refraction of Organic Halogen Compounds. W. Leithe. *Zeits. f. Elektrochem.* 37. *pp.* 623–625, *Aug.–Sept.*, 1931. *Paper read before the Deut. Bunsen Gesell., Vienna, May,* 1931.—Sources of error in previous determinations of atomic refractions of the halogens are discussed. New measurements, with specially pure materials, repeated with various samples, show definitely that constitutional variations occur. The atomic refraction increases with the number of halogens substituted on one carbon atom, or attached to neighbouring carbons. The value deduced from 1.2 substituted derivatives is different from that for 1.3 derivatives. Unsaturated halogen compounds give a lower value when the halogen is directly attached to the unsaturated carbon, but a higher value when it is separated from it. C. B. A.

387. Magnetic Birefringence in Aliphatic Liquids. S. W. Chinchalkar. *Indian Journ. Phys.* 6. *pp.* 165–179, *Aug.*, 1931.—The Cotton–Mouton constant is measured relative to acetone for a number of aliphatic liquids by a method described. The values for ketones decrease as higher alkyls are introduced, water has a lower value than ethyl alcohol, and those for esters are of the same order, but smaller, than for acids. The $C = O$ group is shown to have a strong positive magnetic anisotropy, CH_3 and OH negative ones. The large negative birefringence of CS_2 is due to its strong optical anisotropy, and its magnetic anisotropy is comparable with that of some very anisotropic aliphatic compounds, though smaller than that of benzene. C. B. A.

388. Optical Properties of Some Aromatic Organic Crystals. K. L. Narasimham. *Indian Journ. Phys.* 6. *pp.* 233–240, *Aug.*, 1931.—The optical properties of crystals of diphenyl, phenanthrene and fluorene are studied. The birefringence in each case is less than that of naphthalene. This result is discussed in the light of the chemical constitutions and the crystal structures obtained by X-ray analysis. C. B. A.

389. Optical Rotation and Atomic Dimension. D. H. Brauns. *Bureau of Standards, J. of Research,* 7. *pp.* 573–583, *Sept.*, 1931.—The pure crystalline fluoro- and iodo-derivatives of acetylated mannose have been prepared. The specific rotation values in combination with the revised values of the chloro- and bromo-derivatives of acetylated mannose show a disagreement with the atomic dimension relationship established for the halogen derivatives of other monosaccharides. An explanation of this behaviour is obtained by model studies which show that the hydrogen of the first asymmetric carbon (to which the halogen is also attached) is influenced by atoms of the second carbon acetyl group, whereas such an influence does not exist for the other investigated halogen derivatives of monosaccharides. This result gives a suggestion for the configuration of other acetyl groups. These results show also that the study and testing of the principle of optical superposition should be carried out in the light of these configurational peculiarities. AUTHOR.

390. Single and Superposed Absorption Bands and Their Behaviour in Optical Activity. W. Kuhn and H. L. Lehmann. *Zeits. f. Elektrochem.* 37. *pp.* 549–552; *Disc.*, 552, *Aug.–Sept.*, 1931. *Paper read before the Deut. Bunsen Gesell., Vienna, May,* 1931.—The absorption spectrum of β-octyl nitrite consists of two bands, at about 3650 and 2300 Å., the former being subdivided into four single bands. The rotatory dispersion inside the longer wave-length band is irregular, but when the contributions of the individual components are calculated on the assumption that the anisotropy factor is constant over all four [see Abstract 3975 (1930)], the sum approximates very closely to the observed curve. This indicates that the spatial condition of the vibration corresponding to each of the four components is the same, or that the moment causing the absorption band depends only on the electron transition and not on nuclear vibrations which are superposed on it. A similar result is obtained with the single band of azidopropionic acid ethyl ester, where direct measurement of the circular dichroism gives an almost constant value for the anisotropy inside the absorption band, while the contribution of the band to the rotatory power runs antisymmetrically to the middle point of the band. This is characteristic of an absorption band whose origin is a single electron jump. The centre of the anomaly due to the 2900 Å. band of camphor is displaced considerably towards the red from the centre of the band, and the maximum of circular dichroism is not at the same wave-length as the centre of the absorption. The anisotropy factor, after remaining constant through half the band, falls rapidly to zero. The apparently simple camphor band must therefore consist of two superposed bands of different electronic origin. The intensity of the secondary band can be derived from measurements of the circular dichroism. C. B. A.

391. Kerr Constants of Liquid and Dissolved Substances and the Nature and Origin of the Mutual Influence and Orientation of Liquid Molecules. G. Briegleb. *Zeits. f. phys. Chem.* 14. *Abt. B.* 2. *pp.* 97–121, *Sept.*, 1931.—The Kerr constants of solutions of acetone, ethyl ether, chloroform, carbon disulphide and benzene in heptane, and of pure ethyl ether, benzene, chloroform, heptane, hexane, carbon tetrachloride, toluene and *m*-xylol are measured by a modified compensation method. The dielectric constants, refractive indices and densities of the solutions are also determined. For the calculation of the Kerr constant of a substance in a non-polar solvent, an additive " molecular Kerr constant " is introduced. The dependence of this additivity on the concentration is attributed to molecular association in the case of polar molecules and to mutual influence of the molecules in the case of non-polar substances. From the decrease, with increasing concentration, of the molecular Kerr constant of non-polar molecules dissolved in non-polar solvents and from the change in anisotropy on the transition from gas to liquid, it can be shown, by means of a model, that the non-polar molecules, benzene, carbon disulphide, heptane, etc., orientate themselves with their axes of maximum polarisability parallel. The Kerr constants deduced by extrapolation to infinite dilution are all smaller than those observed for the vapours. This can be explained in the formation of complexes of both polar and non-polar solute with solvent molecules. The dissolved molecule, on account of its behaviour in the electric field and of its polarisability in the alternating field of the light wave cannot be considered as a completely independent unit, even if both it and solvent are non-polar. C. B. A.

392. Kerr Constant of Nitrobenzene. R. Möller. *Phys. Zeits.* 32. *pp.* 697–718, *Sept.* 15, 1931.—The field distribution in the Kerr cell is investigated by three methods, and is found to be non-linear, the position of the minimum depending on the method of purification of the nitrobenzene. The Kerr constant is not affected by the field distribution, although it increases as the conductivity decreases. The final value obtained is $3 \cdot 74 \times 10^{-5}$. The large variations among the previous determinations are explained. Deductions are drawn as to the distribution and type of impurities present in the nitrobenzene. C. B. A.

393. Nitrobenzene Kerr Cell. F. Hehlgans. *Phys. Zeits.* 32. *pp.* 718–727, *Sept.* 15, 1931.—The assumption that the observed inhomogeneity in the electrostatic field of the Kerr cell is caused by impurities in the nitrobenzene is confirmed in two ways. Extremely pure material does not show the effect which can be reproduced by artificial contamination. The experiments show that the determination of the Kerr constant using electrostatic fields is justified, provided the nitrobenzene is sufficiently pure. The form and displacement of the Babinet interference pattern, or the distribution of light intensity in the field of the Kerr condenser, provide convenient tests of the purity of nitrobenzene and similar substances. C. B. A.

394. Optical Analysis of Very Weak Mixtures of Petroleum Vapour. Z. Tuzi and O. Kadita. *Inst. Phys. and Chem. Research, Sci. Papers, Nos.* 316–324, *pp.* 147–158, *Sept.*, 1931.—A description is given of the Doi refractometer, a simplified form of the Jamin instrument, in which one of the two parallel-sided blocks generally employed is replaced by a right-angled prism. A new type of container is employed for the gases and both the light beams pass twice through the container. It is claimed that the new instrument is much simpler to handle than the usual type. In the work described the instrument is employed for measuring the concentration of petroleum vapour in air, and a study is made of the effect of varying the concentration upon the liability to explosion of the mixture. It is concluded that the mixture becomes explosive when a concentration of approximately 1 % by volume of the petroleum vapour is reached. A. H.

395. Optical Measurement of Very Small Displacements. H. Whitaker. *Journ. Sci. Instruments*, 8. *pp.* 251–258, *Aug.*, 1931.—An apparatus is described for measuring very small displacements, consisting of an accessory device, which can be fitted to a standard type of measuring microscope. The method consists in using a fine quartz pointer as a lever, which multiplies the small displacement to be measured. The magnified movement of the pointer is measured up in the field of the microscope provided with eyepiece scale. The theory of the pointer movement is given and various possible sources of error discussed. AUTHOR.

396. Recording Microphotometer. J. H. Lees. *Journ. Sci. Instruments*, 8. *pp.* 273–279, *Sept.*, 1931.—The paper describes a simple recording microphotometer, and discusses the advantages following the use of valve amplification of the photoelectric current. The magnification of the motion of the photographic plate to make the record is done by a form of pulley gearing which is not only accurate but very easily constructed. AUTHOR.

397. Optical Method for the Determination of the Velocity of Rifle Bullets and Gun Shot. J. Taylor and R. Wark. *Journ. Sci. Instruments*, 8. *pp.* 288–295, *Sept.*, 1931.—The paper describes methods of measuring the velocity of rifle bullets and of shot gun ejecta in the neighbourhood of the muzzle. Beams of light which are brought to fine foci at a known distance apart on the line of flight of the projectile throw very intense slits of light on a rotating film. When a projectile passes one of the foci, the light is momentarily cut off and an interception on the film takes place. The nature of the interceptions and the accuracy of measurements are described. AUTHORS.

398. Nephelometer Method for the Measurement of the Efficiency of Fog Filters. G. Stampe. *Zeits. f. Instrumentenk.* 51. *pp.* 400–408, *Aug.*, 1931.—The author discusses the difficulties which arise in determining the degree of purification of gases by the removal of the impurities, solid, liquid or gaseous. Apart from the long time involved in using an ultramicroscope to count the particles before and after passing the filter, the filter itself changes during the test and the mixture tested may not remain constant. In the procedure described paraffin oil particles are used to form an aerosol, this substance having a low vapour pressure and, being chemically inert, non-resinous, non-hygroscopic, of sufficient purity and the drops have a slow rate of fall. The transparency of the cloud is measured with a Pulfrich photometer against a semi-transparent prism. This gives a relative number and the actual value is obtained by using a cloud of known intensity, an ultra microscope counter and particles of a fixed size. Cloud filters are used to eliminate the effects of dispersion. Diagrams illustrate the apparatus used and the results obtained. R. S. R.

399. Apparatus for Measuring the Scattering and Absorption of Light in Clouds and Smoke Gases. H. Sauer. *Zeits. f. Instrumentenk.* 51. *pp.* 408–417, *Aug.*, 1931.—The apparatus employed consists of two cylindrical chambers through which the gases pass. A parallel beam of light from a source enters each and the light scattered at an angle of 45° passes through adjustable slits to a Pulfrich photometer. A series of coloured discs can be rotated in front of the eyepiece. The ratio of the light intensities will depend on the area of the slits and is measured as a percentage by a rotating screw. An immediate comparison of the scattering of two aerosols is thus given. If the gas passes successively through one chamber, a filter and the other chamber, the percentage action of the filter is given. For direct measurement a body of semi-transparent glass, having a known invariable degree of scattering, is put in one chamber and the gas in the other compared with it. To get absorption measurements, the direct transmitted light is received as before in the photometer, and a relation is established between the scattering intensity and the number of particles. The scattering intensity curve has a linear rise for small extinction coefficients but a correction factor is required and the value is obtained. The absorption and scattering of light both increase as the wave-length (λ) of the light used decreases from the region of maximum scattering. For very small particles the scattering $\propto \lambda^{-4}$, but with increased size the dependence is less and finally is zero. A comparison is given of observed and calculated scattering intensities for cigarette smoke and other media before and after correction. Applications of scattering and absorption measurements are given. R. S. R.

400. Optical Spectro-Integrator. S. Rösch. *Zeits. f. techn. Physik*, 12. 9. *pp.* 410–417, 1931.—When the spectral distribution curve of reflection, transmission, etc. has been determined for any given body, its integral reflection factor, etc., can be found by multiplying the reflection factor at each wave-length by the visibility factor at that wave-length and then integrating throughout the visible spectrum. Similarly, the trichromatic colour coefficients can be found by multiplying the reflection factor at each wave-length by the ordinates of the red, green and blue mixture curves at that wave-length and then forming the integral for each colour. The author describes an instrument by means of which such integrations can be performed optically. The spectral reflection-factor curve is first reproduced as an opening in a black-paper diaphragm. Then the visibility curve (or one of the mixture curves) is reproduced in the form of a photographic " wedge." Alternatively, there may be substituted a

special form of sector disc in which the openings are so shaped that the transmission at different points is proportional to the visibility (or the red, green or blue sensation) at that part of the spectrum. An optical instrument provides a parallel beam of light which passes through (*a*) the reflection-factor diaphragm and (*b*) the photographic wedge or the sector disc. The light which gets through is proportional to the product and so gives the integral required by means of a simple photometric measurement.
J. W. T. W.

401. Fresnel Diffraction: High-Order Interference. W. Müller. *Ann. d. Physik,* 11. 2. *pp.* 177–189, *Sept.* 11, 1931.—The development of an optical method of determining the thickness of cylindrical wires has necessitated a careful investigation of the Fresnel diffraction patterns produced by them. A photographic method for this is described, and also the photometric measurement of the patterns obtained. The results are compared with the values deduced from the theories of Fresnel and of Ignatowski. They agree only in the case of wires of 1 mm. dia. or more. For thinner wires, both theories diverge from experiment, though that of Ignatowski gives slightly the better values.
C. B. A.

402. Zehnder-Mach Interferometer. G. Hansen. *Zeits. f. techn. Physik,* 12. 9. *pp.* 436–440, 1931.—To obtain the temperature distribution in gases near heated bodies an optical interference method is used. With the Michelson arrangement the fringes produced are near the mirror, but the fringes were required to be formed at a distance from the mirrors. It is shown mathematically how with an apparatus consisting of four mirrors, two highly-reflecting and two semi-transparent, the position and breadth of the interference fringes depend on the positioning of the mirror, and what size of mirror should not be exceeded in order that for a certain width of fringes no mixing of the fringes occurs. An arrangement is described with which the interference phenomena can be produced and photographed with a short exposure in white light. Diagrams illustrate the results obtained with a heated metal tube.
R. S. R.

403. Quartz-Fluorine-Water Objective, Achromatic between 1850 and 7000 Å. P. Bricout. *Rev. d' Optique,* 10. *pp.* 345–352, *Sept.,* 1931.—To obtain achromatism over the desired wide range considerations in the choice of quartz, fluorine, calcspar and rock-salt are first examined while the necessary absence of anomalous dispersion in the range necessitates the use of distilled water as the liquid. The method of calculation employed to get the constants of the lenses is explained and applied to the doublets quartz-fluorine, quartz-water and fluorine-water. Finally, a meniscus of distilled water is inserted between two quartz lenses, and this can be removed and replaced when desired. The fluorine lens is slightly removed from the others and in front. This system has a focal distance constant to 1 mm. almost, between 1850 and 7000 Å. Curves show the spherical aberration for various rays. The variation of the focal plane is less than 1 mm. for 15° C. change, a negligible amount in practice. It is thus possible to realise with this arrangement a universal spectrograph of fixed extension regulated by visual observation.
R. S. R.

404. Resolving Power of Photographic Objectives. G. v. Kujawa. *Zeits. f. techn. Physik,* 12. 9. *pp.* 440–444, 1931.—The method described involves the use of a collimator with a long-focus telescope objective, and an image of a double slit is obtained on a photographic plate. The image is obtained with different angles of the meridian plane, and the photographic plate is examined with a registering photometer, or, more accurately, with a microphotometer. The errors are indicated comparatively. This method gives the resolving power of the photographic objective according to (1) decrease of brightness at an edge, (2) resolution of double lines, and (3) the scattering cross. R. S. R.

405. Investigation of Telescope Objectives by Means of Interference Diagrams and Autocollimation. A. Wetthauer. *Zeits. f. Instrumentenk,* 51. *pp.* 393–396, *Aug.*, 1931. *From the Reichsanstalt.*—The use of an additional objective in testing another leads to complications, in that errors of the first are added to those of the second. For short focus objectives this can be largely decreased by using a long-focus objective as the accessory, but this method is not suitable for telescope objectives. The author passes light from a bright source through a right-angled prism having one of its short faces perpendicular to the axis of the objective to be tested and with three parallel slits on this face close to the angle of 45°. The light passes thence through the objective, a special type of zonal slit, and to a plane mirror which reflects it back at a small angle to its incident direction. A picture of the slits is formed on a photographic plate near to the prism slits. By rotation of the zonal slits the spherical aberration is obtained, while by change of wave-length for the source the chromatic aberration is obtained. The astigmatism can be tested by rotating the objective in its support. Diagrams illustrate the results obtained. R. S. R.

406. Fixed Points of a Colorimetric System. J. Guild. *Optical Soc., Trans.* 32. 1. *pp.* 1–36, 1930–1931.—The paper discusses the significance of the constants which enter into the specification of colour on the trichromatic system, and suggests certain fundamental considerations of a metrological character which ought to govern the choice of such constants in a standard reference system. Various proposals which have been put forward from time to time are discussed in the light of these considerations, and the basis of the system which has been adopted at the National Physical Laboratory is explained. AUTHOR.

407. Colorimetry. H. Pese. *Zeits. f. techn. Physik,* 12. 9. *pp.* 418–421, 1931.—The author examines critically the basis of L. Bloch's method of trichromatic colorimetry, using three colour filters [see Abstract 1560 (1923)]. He points out that a photometric measurement made through any such filter is not free from the difficulties of heterochromatic photometry. Even more serious is the defect that the results obtained are dependent on the transmission curves of the filters used. These objections apply equally to all methods employing coloured filters. It is pointed out that it is not possible to calculate the Ostwald colour coefficients from the values obtained by Bloch's method. J. W. T. W.

408. Fundamental Curve of Colour Sensation. H. Schulz. *Zeits. f. techn. Physik,* 12. 9. *pp.* 421–424, 1931.—Assuming the validity of a formula similar to Wien's, the values of the constants are calculated. The results are in good agreement with the international values of sensitivity and with those of Ives, except at the red and violet ends, where deviation might be expected. H. M. B.

409. Interpolation of the O. S. A. "Excitation" Data by the Fifth-Difference Osculatory Formula. D. B. Judd. *J.O.S.A.* 21. *pp.* 531–540, *Sept.*, 1931.—In order to compute the dominant wave-length and purity of a colour stimulus by means of the O. S. A. "excitation" data, two values must be obtained by interpolation. The adoption of the osculatory formula for this interpolation permits the computations to be made with perfect reproducibility. Each of the O. S. A. curves by this method is represented as a series of parabolæ of the fifth degree which join at the values specified at every 10 mμ so as to have a common slope and curvature at the junction point. Interpolated values have been computed according to this formula for every millimicron. AUTHOR.

410. Photoelectric Colorimetry. H. E. Ives and E. F. Kingsbury. *J.O.S.A.* 21. *pp.* 541–563, *Sept.*, 1931.—This paper is mainly concerned with the peculiarities of various types of photoelectric cells, and the effect of these peculiarities on the use of the cells for trichromatic colorimetry or spectrophotometry. In the first place it is shown that the photoelectric current is not strictly proportional to the illumination, especially if the latter be high, or the voltage on the cell be raised. Gasfilled cells and highly sensitive cells of the vacuum type also show a marked departure from a linear characteristic. The spectral response curve is dependent on whether or not the cell is exposed to infra-red radiation. More generally the response at any given wave-length depends on the presence or absence of other wave-lengths in the light falling on the cell. Further, the spectral response curve of a given type of cell depends on the previous history of the cell. It also varies over the sensitive surface, *i.e.*, it is not the same at all parts of this surface. The voltage-current characteristic is different at different parts of the spectrum, so that the spectral response curve is different at different voltages. The author concludes that any direct-reading method, with the cells now available, is out of the question where any high accuracy is required. A substitution method must be used, and there must be sufficient quickness of alternation of the two stimuli and proper optical conditions for minimising the effect of the alternation. Properly used, photoelectric cells will give a more sensitive discrimination of small brightness differences than will the eye. The use of amplification systems is briefly considered. J. W. T. W.

411. Error in Reflectivity Measurements with Integrating Spheres. A. C. Hardy and O. W. Pineo. *J.O.S.A.* 21. *pp.* 502–506, *Aug.*, 1931.—There are two methods of measuring reflection factors by means of an integrating sphere. In the first method the test sample and a standard sample are placed one after the other over a small aperture in the sphere and their relative brightnesses, b and B are measured. It is generally assumed that $r/\mathrm{R} = b/\mathrm{B}$, where r and R are the reflection factors. Actually, the authors show that $r/\mathrm{R} = (b/\mathrm{B})\ (1 + x)$, where x is a correction factor and is equal to $a(\mathrm{R} - r)/\{1 - s(1 - a - \alpha) - a\mathrm{R}\}$, a and α being the areas of the sample and of the other apertures, relative to the area of the sphere, while S is the reflection factor of the sphere surface. If S is 0·97 (as for magnesium oxide), while a and α are 0·01, the correction factor is 0·252 $(\mathrm{R} - r)$, so that if the test sample differs much from the standard, a large error is introduced by taking $r/\mathrm{R} = b/\mathrm{B}$. In the second method, in which both standard and test sample are in place throughout the experiment, the error is much less. J. W. T. W.

412. Spectrophotometry. K. S. Gibson. *J.O.S.A.* 21. *pp.* 564–587, *Sept.*, 1931.—Describes the various methods used in the colorimetry section of the Bureau of Standards. For the visual method the König-

V. 19

Martens instrument is used. The measurement of transmission presents no difficulties. Reflection measurements need a very high illumination of the sample and of the magnesium oxide specimen (or opal glass) used as a standard comparison surface. Diffuse illumination is used, but the heating of the sample is sometimes so great as to produce a progressive change of reflection during a test. This is allowed for by extrapolation when it cannot be prevented by forced draught playing on the sample. As a check on the visual method a photoelectric method is employed. This covers the range 380 to 600 mμ. Both potassium and cæsium cells have been used. For the red and infra-red regions a thermoelectric method is employed, embodying a thermopile and galvanometer. This method can be used up to 2000 mμ. In the ultra-violet region (500–220 mμ) the photographic method is adopted. This is, in essence, the method of the Hilger sector-photometer. The author gives a number of diagrams showing the agreement obtained between the various methods where these overlap. One disadvantage of the visual method is the effect of stray light when making measurements at the red end, even if a red filter be used over the eyepiece. Similarly stray energy may give considerable errors when the thermoelectric method is being used. The estimated uncertainty in the transmission of a certain blue glass measured by all three methods did not exceed 0·002 below 500 mμ and 0·005 above 650 mμ. J. W. T. W.

413. Spectrophotometry of Coloured Materials by Photoelectric Methods. M. Barnard and P. McMichael. *J.O.S.A.* 21. *pp.* 588–604; *Disc.*, 605–614, *Sept.*, 1931.—Describes the requirements of a photoelectric spectrophotometer for use in determining the absorption characteristics of coloured materials. The results obtained with the instrument marketed by the American Photoelectric Corporation are described at considerable length, but no description of the instrument, or of its principle, is given. In the *Discussion*, **I. G. Priest** and **D. B. Judd** showed what degree of colorimetric uncertainty was represented by the uncertainty indicated by the authors for the spectrophotometric data. P. McMichael presented additional data on another colour filter, confirming the results given in the paper. J. W. T. W.

414. Photometric Consequences of the Growth of the Latent Image. P. C. Keenan. *Astrophys. J.* 74. *pp.* 105–109, *Sept.*, 1931.—The opinion of investigators of the subject favours the view that the latent image continues to increase in intensity for a few hours after exposure and then tends to fall off again. Tests to determine the practical photometric consequences of this effect on ordinary plates show that increases of density of the order of 10 % occur after two hours; hence, serious errors in precise photometric comparisons may result if this is not taken into account. AUTHOR.

415. Methods of Representing Photographic Sensitivity. R. Davis and G. K. Neeland. *Bureau of Standards, J. of Research,* 7. *pp.* 495–517, *Sept.*, 1931.—The relation between photographic sensitivity and the amount of development has been studied, using as indices of sensitivity three modifications of Hurter and Driffield's method of measuring plate speeds. The results are generally in accord with those of Bullock, who investigated the relation of threshold speed to development time. An optimum time of development is indicated which varies with the type of emulsion considered. The study brought out the differences between the three indices considered and led to the conclusion that no single value is adequate to represent the sensitivity of a given emulsion. It is more satisfactory to represent the sensitivity of an emulsion in terms of a curve plotted between a sensitivity index and development time. AUTHORS.

416. Spectral Fluorescent Efficiencies of Certain Substances with Applications to Heterochromatic Photographic Photometry. G. R. Harrison and P. A. Leighton. *Phys. Rev.* 38. *pp.* 899–908, *Sept.*, 1931.—The intensity of fluorescence of a number of different substances when illuminated with light of the same intensity at different wave-lengths has been measured and found to be such that the number of quanta emitted was practically proportional to the number of incident quanta over a wide range. Small traces of impurity produce wide deviations in response, thus accounting for the results of other work in disagreement with these results. The general relation is applied to heterochromatic photographic photometry useful in the range 3900–2000 Å., and it is believed that it will be possible to extend it to the Schumann region. The method consists in allowing the spectrum to fall on a fluorescent layer which is photographed or by coating the spectrum plate with the fluorescent substance which shows not only constant contrast but constant quantum efficiency over a large spectral region. J. E.

417. Irreversible Alteration in the Fluorescent Spectrum of Hæmatoporphyrin. S. Rafalowski. *Zeits. f. Physik,* 71. 11–12. *pp.* 798–806, *Sept.*, 1931.—It has been shown that the alterations in the fluorescent spectrum of hæmatoporphyrin in glycerin and ammonia solutions produced by light, heat and change of concentration is due to reaction with oxygen dissolved in the solution. J. E.

418. Quenching of Resonance Radiation and the Concentration of Metastable Atoms in Mercury Vapour. H. Magliano and E. Gaviola. *Univ. Nac. La Plata, Estudio Ciencias,* 5. *No.* 93. *pp.* 479–498, *Sept.*, 1931.—The quenching of resonance radiation is studied on the basis of the measurement of Stuart [see Abstract 2077 (1925)]. Previous results are discussed and a general quenching formula is given which applies at the same time to transitions to the normal and to the metastable levels. This formula, in which results of Foote, Klumb and Pringsheim and Gaviola are embodied and in some points modified, is in good agreement with experiment and removes some previous difficulties. The efficiency of CO is shown to be constant with pressure (in contradiction with previous results) and the collision radius of the excited mercury atom is found to be not much larger than the one found for H_2—and may well be the same—assuming the same total efficiency. Owing to the fact, as it is shown, that all the numerical results depend on geometrical conditions of the experiment, which are not well known, all that can be said is that the radius of the excited mercury atom lies between the one of the normal atom and about twice that value. The efficiency factors for H_2 and CO are assumed to equal unity. The absorption factor of Foote is found to be less than 0·2. This result modifies the numerical values of Foote and Gaviola for efficiencies and radius of collision. [See also Abstract 3427 (1930).] AUTHORS.

419. Resonance Series of Bismuth Vapour. J. Parys. *Zeits. f. Physik,* 71. 11–12. *pp.* 807–813, *Sept.* 26, 1931.—Saturated Bi vapour at 800° C. was excited by the light from a mercury-vapour lamp. The observed fluorescence consists of three doublet series of which two are excited by 4358 Å. and the other by 5461 Å. Series formulæ are obtained and rotation quantum numbers obtained therefrom. J. E.

420. Comparison of Sources for Zinc Resonance Radiation. A. C. G. Mitchell. *Frank. Inst., J.* 212. *pp.* 305–316, *Sept.*, 1931.—An experimental comparison has been made with the following types of sources; discharge tube, hot-kathode arc and hollow-kathode discharge tube. Photographs are shown of the densitometer curves of the line 3075 Å. taken with the different sources. The conclusion reached is that any of the sources is good enough for studies on quenching and polarisation, but none for the study of the polarisation of stepwise radiation. The most convenient and economical source would seem to be the hot-kathode arc. J. E.

421. Spectrum of the Hydrogen-Nitrous Oxide Flame. A. Fowler and J. S. Badami. *Roy. Soc., Proc.* 133. *pp.* 325–332, *Sept.* 1, 1931.—The spectrum of the bright cap or cone near the base of the hydrogen-nitrous oxide flame is shown to be similar to that of the ammonia-oxygen flame. Each shows bands due to the molecules NH, HO and NO, and the so-called "α-bands" of ammonia, provisionally attributed to NH_2. The Schuster bands, probably due to NH_3, were not observed. The NH and HO bands are stronger and the NH_2 bands weaker than in the case of ammonia. The outer cone in each case shows only bands of HO and a continuous spectrum. F. S.

422. Theory of Perturbations in Band Spectra. G. P. Ittmann. *Zeits. f. Physik*, 71. 9–10. *pp.* 616–626, *Sept.* 19, 1931.—A theory of the perturbations in doublet band spectra is developed taking into account the effect of electron spin. Several phenomena observed in the CN, SiN and N_2^+ bands find an explanation on the basis of these calculations. J. E. K.

423. Ultra-Violet Emission of Calcium Oxide Phosphors. O. Schellenberg. *Ann. d. Physik*, 11. 1. *pp.* 94–102, *Sept.* 2, 1931.—The emission of calcium oxide phosphors, containing various metals, between 2000 and 5000 Å. has been examined. The emission consists always of a variable number of superimposed bands of different intensities. Manganese and copper, which are inactive in calcium sulphide, produce ultra-violet emission with calcium oxide, that due to copper being especially intense. The influence of temperature on the ultra-violet emission differs from that on the emission in the visible; the intensity and duration of the latter is a maximum at 200°–300° C., whereas for the ultra-violet emission the greatest intensity occurs at room temperature, only the first bands being emitted at higher temperature. At −180° C. all the bands vanish, except those of calcium oxide–bismuth. H. F. G.

424. Measurement of Absorption Spectra in the Ultra-Violet. H. Conrad-Billroth. *Zeits. f. phys. Chem.* 14. *Abt.B.* 2. *pp.* 122–134, *Sept.*, 1931.—The points of equal intensity in double-spectra obtained on a photographic plate by one of the usual photometer methods are identified mechanically by means of a special photometer which is described. The intensities of the two spectra are recorded by separate thermopiles which can be connected in opposition, so that at a point of equal intensity null deflection of the galvanometer is obtained. A continuous source is used for obtaining the plates, so that wave-lengths have to be interpolated.

Values are found to be reproducible to 1 or 2 %, the absolute accuracy in extinction-coefficients being 3 or 4 %. C. B. A.

425. Absorption Spectra of Radiated Uracil and Other Compounds. F. F. Heyroth and J. R. Loofbourow. *Am. Chem. Soc., J.* 53. *pp.* 3441–3453, *Sept.,* 1931.—The ultra-violet absorption spectra of uracil, dichloromethylpyrimidine, odenine and thymus nucleic acid are discussed, particularly with reference to the changes in absorption due to irradiation. These changes are described as twofold: (1) An early increased absorption in regions of low absorption adjacent to bands, and (2) a later gradual loss of all noteworthy selective absorption. Explanations are discussed, as well as possible biological significance. W. V. M.

426. Near Infra-Red Absorption Spectra of Ergosterol and Irradiated Ergosterol. Elizabeth Shellow. *Bull. Basic Sci. Research,* 3. *pp.* 175–200, *Aug.,* 1931.—A preliminary investigation of the infra-red spectra between $0{\cdot}8\,\mu$ and $3\,\mu$ of ergosterol and irradiated ergosterol indicates that the alcohol group does not disappear and that the ketone group does not develop as a result of irradiation with ultra-violet light of wave-length longer than 2960 Å. There is some indication of the presence of ketone derivatives among the products of irradiation with unfiltered ultra-violet light. The general form of the infra-red absorption curve of ergosterol irradiated with long wave-lengths resembles that of ergosterol and isoergosterol. These findings suggest that vitamin D is an alcohol isomeric with ergosterol. AUTHOR.

427. Band Spectrum of Benzene: Existence of a Small Vibrational Frequency in the Normal State. C. V. Shapiro, R. C. Gibbs and J. R. Johnson. *Phys. Rev.* 38. *pp.* 1170–1178, *Sept.* 15, 1931.—A vibrational frequency of 160 cm.$^{-1}$ in the band spectrum of benzene, postulated by Henri but called into question by Kronenberger and Pringsheim, is discussed from the point of view of the available spectral and Raman data, but no definite conclusion as to its origin in the normal state of the molecule is reached. Experimental evidence is then brought forward to show that the observed intensity distribution of absorption bands having this separation corresponds closely to the distribution calculated from the Boltzmann law with the addition of certain reasonable assumptions, on the basis that the 160 cm.$^{-1}$ frequency occurs in the normal state. Further checks are obtained by repeating the measurements and calculations for higher temperatures. The possible origin of this small vibrational frequency in the benzene molecule is briefly discussed. AUTHORS.

428. Vibrational Quantum Analysis of the Visible Absorption Bands of Bromine. W. G. Brown. *Phys. Rev.* 38. *pp.* 1179–1186, *Sept.* 15, 1931.—The absorption bands of bromine from 5100 Å. to 7600 Å. are classified into two band systems having a common lower level. One of these includes nearly all of the previously recorded bands of bromine, while the other comprises a group of relatively weak bands lying in the extreme red. The upper level of the extreme red system differs from that of the main system in that it dissociates into normal atoms. Measurements of the vibrational isotope effect are given for a number of bands in the main system leading to a revision of the quantum numbering and of the vibrational constants. AUTHOR.

429. Infra-Red Absorption Band System of Iodine. W. G. Brown. *Phys. Rev.* 38. *pp.* 1187–1189, *Sept.* 15, 1931.—A vibrational analysis is given for a group of weak bands observed between 8300 Å. and 9300 Å. in the absorption spectrum of saturated iodine vapour at temperatures between 80° and 150° C. The system is analogous to the extreme red system of bromine, being due to transitions from the normal state to an electronic state of small D value ($\sim 0{\cdot}08$ volts) dissociating into normal atoms. A region of continuous absorption, presumably associated with the band system, and having a maximum at 7320 ± 50 Å. has been observed. AUTHOR.

430. Number of Excited Atoms and Absorption Spectra of Metallic Vapours. A. T. Williams. *Univ. Nac. La Plata, Estudio Ciencias,* 5. *No.* 93. *pp.* 499–513, *Sept.*, 1931.—The validity of the equation $N_1/N = e^{-E/RT}$, where N_1 is the number of excited atoms and N the total number of atoms, has been established by measurements of the absorption spectra of vapours of a variety of metals. For $N_1/N \geqslant 1/10$, strong, medium and faint lines appear, and as the ratio diminishes only the fainter lines appear, until for $N_1/N \leqslant 1/28{,}000$ no absorption lines at all are observed. The anomalous results obtained with thallium, nickel and antimony are discussed. In general, for the absorption lines $\Delta l = -1$, and Δj is then 0 or -1, or, in a few exceptional cases, $+1$; for $\Delta l = 0$, $\Delta j = 0$ or ± 1, and for $\Delta l = +1$, $\Delta j = +1$. H. F. G.

431. Spectroscopic Study of the Dissociation Relationships of Metal Halides in Solution. H. Fromherz. *Zeits. f. Elektrochem.* 37. *pp.* 553–558; *Disc.*, 558–559, *Aug.–Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—The absorption spectra of the alkali and alkaline earth halides, including those of lithium, at 200–400 mμ have been studied at concentrations up to 10 M. The absence of any considerable change of position of the absorption maximum with increase of concentration indicates that association in the sense of chemical compound formation does not take place in concentrated solution, and that such association must be of the nature of ionic swarm formation. This does not apply, however, to halides in which the kation has not the inert gas configuration. Thus in dilute lead chloride solution the absorption curve corresponds with that of the hydrated lead iron, but with increase of concentration a band at about 227 mμ, due to a single complex, *viz.*, $PbCl'$, becomes increasingly apparent. If alkali halide is added to a lead chloride solution, a strong band, due to $PbCl_4''$, appears at 272 mμ. Similar results are obtained with solutions of thallous and cadmium chlorides. The mercuric chloride bands are hardly altered by dilution of the solution, as they arise from the stable undissociated molecule, but on addition of an excess of alkali halide the bands due to complex coordination halides appear; these compounds also appear to be very stable. H. F. G.

432. Absorption Spectra of Mercury and Cadmium Halide Vapours. K. Butkow. *Zeits. f. Physik,* 71. 9–10. *pp.* 678–689, *Sept.* 19, 1931.—The absorption of CdI_2, HgI_2 and $HgBr_2$ vapours have been obtained from 7000 to 1950 Å. Absorption maxima in the ultra-violet corresponding to different states of dissociation have been found. The comparison of the absorption spectra of the vapours with those of solution show similarity, but the absence of the solvent brings out far more maxima in the vapour spectra. J. E.

433. Band Absorption of Mercury Vapour in the Extreme Ultra-Violet. N. Kremenewsky. *Zeits. f. Physik*, 71. 11–12. *pp.* 792–797, *Sept.* 26, 1931.—The source of light was a hydrogen lamp, the light from which passed through a tube containing mercury vapour, which could be heated in an electrical oven; it then passed through the slit of a vacuum spectrograph, with a concave grating. A certain amount of helium was mixed with the mercury vapour. Continuous bands were observed at 1850, 1807, 1694 and 1403 Å., due to absorption in the mercury vapour. The behaviour of these bands at different temperatures up to 340° C. is described. In addition to the above, between 280° C. and 305° C. a series of diffuse absorption bands appeared near 2100 Å, in the region of Steubing's fluorescence bands. These converge towards $\lambda < 1900$ Å., and can be connected with the 2^1P term of the mercury atom. A table contains the values of λ in Å., $\Delta\lambda$, ν in cm.$^{-1}$, and $\Delta\nu$ for twenty-one of these bands. H. N. A.

434. Effect of Temperature on the Continuous Band Spectrum of Mercury Vapour. W. M. Nielsen. *Phys. Rev.* 38. *pp.* 888–898, *Sept.* 1, 1931.—The continuous bands of mercury vapour at 4850 Å. and 3300 Å. were excited by electron impact in the vapour at high pressures (1 to 10 mm. of mercury) and low electron currents (1×10^{-6} ampere). Under such conditions the luminous regions are limited to striations. The potential difference between striations corresponds to approximately 5 volts. Under the experimental conditions the excitation of the lower excited states of the mercury atom appears to be essential for the emission of the bands. A complementary variation in intensity of the two bands is observed. The 3300 Å. and 4850 Å. bands are more intense at the kathode and anode respectively than they are in other portions of the discharge space. The variation in intensity of 2537 Å. parallels that of the 3300 Å. band. A measurement of two temperatures enabled the calculation of the temperature at the different striations from which the relative numbers of atoms in the $^3P_1$ and $^3P_0$ states are determined from well-known properties of resonance and metastable atoms. It is shown that the ratio of the intensity of the 4850 Å. band to that at 3300 Å. is directly proportional to the ratio of the population of the $^3P_0$ and $^3P_1$ atomic states. The conclusion is that the excitation of the $^3P_0$ state is essential for the radiation of the 4850 Å. band and that the $^3P_1$ state is associated with the 3300 Å. band. AUTHOR

435. High-Frequency Spectrum of Mercury and the Fine Structures of λ6123 (Hg I) and λ4797 (Hg II). S. Tolansky. *Phys. Soc., Proc.* 43. *pp.* 545–553, *Sept.*, 1931.—It is shown that the previously reported intensity-modifications [see Abstract 130 (1931)], found to take place in the h.f. electrodeless discharge in mercury vapour at low pressures (0·001 mm.) can be completely explained in terms of recently determined electron-impact excitation curves. The modified spectrum arises from the fact that the mean free path is large, enabling the electrons to attain high velocities which result in the strengthening of lines involving upper singlet levels. The h.f. spectrum at a pressure of 3 mm. is found to be arc-like, supporting the above conclusion. The fine structure of the unclassified line λ6123 (Hg I) is determined with a Fabry-Perot interferometer and found to have eight components. Four of these form a multiplet and may arise from one isotope only. The line λ6123 probably involves an upper singlet level. The unclassified spark line λ4797 (Hg II) shows four fine-structure components, widely separated and of similar intensities. AUTHOR.

436. Life of Metastable Mercury and Evidence for a Long-Lived Metastable Vibrating Nitrogen Molecule. M. L. Pool. *Phys. Rev.* 38. *pp.* 955–966, *Sept.* 1, 1931.—Curves showing the rate of decay of the metastable 2^3P_0 state of the mercury atom in a quartz resonance cell, containing carefully purified nitrogen at room temperature, are not accurately exponential. A high concentration of nitrogen molecules excited to the first and second vibrational states of zero electronic moment might be expected, due to collisions of the second kind between normal nitrogen molecules and mercury atoms in the 2^3P_1 or 2^3P_2 states. It is assumed that collisions between metastable mercury atoms and these excited nitrogen molecules will influence the rate of decay of the former. An equation for the number of metastable mercury atoms is obtained of the form $N = N_0 exp[- \alpha t + A(e^{-\beta t} - 1)]$. Evaluation of the constants from experimental data gives for the maximum observed life of the vibrating metastable nitrogen molecule $0 \cdot 52 \times 10^{-3}$ sec., and for the metastable mercury atom $2 \cdot 54 \times 10^{-3}$ sec. The diffusion coefficients and distances between centres at impact are also given for these molecules. J. E. K.

437. Diffuse Bands in Mixtures of Ammonia and Excited Mercury Vapour. A. C. G. Mitchell. *Frank. Inst., J.* 212. *pp.* 341–342, *Sept.*, 1931.—The bands first reported in this mixture by Dickinson and Mitchell [see Abstract 1567 (1927)] have been further studied using a small quartz spectrograph with wide slit. The fluorescence seems to be one band extending from about 2700 Å. to beyond 5461 Å. It is not identical with the bands in boiling mercury investigated by Hontarmans [see Abstract 2067 (1927)]. F. S.

438. Rotation-Oscillation Spectrum of Ammonia. G. Jung and H. Gude. *Zeits. f. Elektrochem.* 37. *pp.* 545–548; *Disc.*, 548, *Aug.–Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—As a means of investigating the relation of the gaseous phase to the condensed phases, *i.e.*, liquid and dissolved, the rotation-oscillation spectrum in the visible region has been investigated for all phases. In the case of the gas the absorption was determined of a column 17 m. long. Effects of solution on the third and fourth overtones show a movement of the bands to longer wave-length, the movement being, however, less than that for liquid ammonia. The relation of movement of the bands to concentration is also studied. F. S.

439. Ultra-Violet Bands of Carbon Monoxide in the Electrodeless Ring Discharge. H. P. Knauss and J. C. Cotton. *Phys. Rev.* 38. *pp.* 1190–1194, *Sept.* 15, 1931.—The relative intensities of the band systems of CO in the region 2900 to 2150 Å. obtained in an electrodeless ring discharge at various pressures were observed, and compared with Geissler tube spectra. A continuous wave oscillator using 100 watts at 6400 kc. was used to produce the ring discharge. The Cameron band system was well developed in the ring at low pressures, in contrast with results obtained by Herzberg, who failed to obtain it in the ring excited by damped oscillations. The 0–1 band at 2157 Å. was observed in addition to previously known members of the system. In the ring at all pressures, the first negative bands (CO^+) were strong, indicating the presence of ions in the ring. The comet-tail bands, due to the same ion, appeared only at low pressures. The fourth positive band system is very strong in the Geissler tube, and in the ring at high pressures. At low pressures it is very weak in comparison with the Cameron bands. The observations show that the electrodeless ring discharge affords a means of selective excitation of certain band systems, and should prove of value in the study of overlapping systems. AUTHORS.

440. New Bands in the S_2 Spectrum. W. E. Curtis and S. Tolansky. *Univ. Durham Phil. Soc., Proc.* 8. *pp.* 323–331, 1930–1931.—The emission band spectrum of S_2 is investigated in the region 4800 to 6600 Å. A large number of bands are discovered in this region, the positions of the band-heads are tabulated and vibrational quantum numbers are allocated to them. In addition to the main band system a set of weaker band-heads is discovered which probably originates from a second electron transition, the lower level of which is the same as that of the main system. The weaker band system cannot arise from an isotope effect. J. E. K.

441. Distribution of Intensity in the Continuous Bands of the Hydrogen Spectrum. L. Goldstein. *Comptes Rendus,* 193. *pp.* 485–488, *Sept.* 28, 1931.—A mathematical treatment of the intensity distribution in the continuous spectrum which under certain experimental conditions appears superimposed on the line spectrum; the primary hypothesis is that the spectrum arises from transitions from the triplet level to the unstable fundamental triplet state $1^3\Sigma$. The equation obtained shows that the maximum intensity occurs at the short wave-length limit of the band, a result which is in accordance with the experimental data. H. F. G.

442. First Spark Spectrum of Rubidium (RbII). O. Laporte, G. R. Miller and R. A. Sawyer. *Phys. Rev.* 38. *pp.* 843–853, *Sept.* 1, 1931.—The resonance lines of RbII have been photographed in the extreme ultra-violet region with the vacuum spectrograph. The mode of excitation was the hollow kathode discharge in helium, and in addition, the hot spark was employed with rubidium hydroxide in cored aluminium electrodes. The values of the wave-lengths of the ultra-violet lines for RbII were obtained from third order measurements. The visible region was photographed with various glass and quartz spectrographs. With the separations of the resonance lines as guides, the classification scheme given by Reinheimmer was found to be correct, but incomplete. Some lines taken from Otsuka's data were fitted into the scheme. The coupling is of an intermediate type approaching that of (jj) form. Levels of the $4p^54d$, $4p^55s$, $4p^55p$, $4p^55d$ and $4p^56s$ configurations were identified. Their separations were compared with KrI. It was also attempted to separate the $^3P_2$ and $^3P_1$ terms due to $4p^5(5s, 6s)$ from the $4p^5(4d, 5d)$ levels. The limit of excitation furnished by metastable helium falls exactly between the various levels caused by the $4p^55p$ configuration, thus providing a check on the interpretation of the classification. The ionising potential of RbII was calculated to be 27·3 volts. AUTHORS.

443. First Spark Spectrum of Indium, InII. R. J. Lang and R. A. Sawyer. *Zeits. f. Physik,* 71. 7–8. *pp.* 453–459, *Sept.* 3, 1931.—The spectrum was excited in a hollow kathode discharge in helium and also in neon. The method was the same as that employed by the authors in investigating the GaII spectrum. The analysis of the singlet and triplet terms is similar to that for AlII and GaII, but the intercombinations are more numerous for InII. The strong discrepancy in the 3F terms with the series formula, and with the interval rule, is worthy of remark. The ionisation voltage, 18·79 volts, follows from the deepest term, $^1S = 152,213$ cm.$^{-1}$. H. N. A.

444. Emission Spectrum of Sodium Hydride. T. Hori. *Zeits. f. Physik*, 71. 7–8. *pp.* 478–531, *Sept.* 3, 1931.—The author has previously studied the absorption spectrum from 3680 to 4450 Å., and has now worked on the emission spectrum, which extends from 3540 to 5050 Å., and is much more complicated. From the analysis of the two spectra it appears that the whole spectrum belongs to a $^1\Sigma \rightarrow {}^1\Sigma$ system. The moment of inertia of the normal state is $5\cdot65 \times 10^{-40}$ gm. cm^2., that of the excited state is $14\cdot66 \times 10^{-40}$ gm. cm.^{2} The formula for nuclear vibrations calculated from the zero lines is

$$\nu = 23{,}696\cdot1 + 335\cdot24\,\mu' + 4\cdot416\,\mu'^2 - 0\cdot3147\,\mu'^3 + 0\cdot00756\,\mu'^4 - 0\cdot000089\,\mu'^5 - (1170\cdot8\,\mu'' - 18\cdot9\,\mu''^2),$$

where the positive sign of the third term shows a remarkable anomaly in the course of the vibrational interval $\Delta\nu'$. The dissociation energies of the normal and excited states are 2·24 and 1·47 volts. The normal molecule breaks up into a Na and a H atom in the ground state, the excited molecule into an excited 2^2P Na atom and a normal H atom. A sodium arc in a hydrogen atmosphere was used to produce the emission spectrum. H. N. A.

445. Spectra of Trebly and Quadruply Ionised Antimony, SbIV and SbV. J. S. Badami. *Phys. Soc., Proc.* 43. *pp.* 538–544, *Sept.*, 1931.—A study of the spark spectrum of antimony under varying conditions of excitation has led to an extension of the existing classification of the spectrum of SbIV. Many new lines are classified as secondary members of the series. A second P-term has been established for the SbV spectrum. AUTHOR.

446. Spectrum of Barium Fluoride in the Extreme Red and Near Infra-Red. T. E. Nevin. *Phys. Soc., Proc.* 43. *pp.* 554–558, *Sept.*, 1931.—A considerable number of new heads in the known system of bands in the extreme red, due to BaF, have been observed. A new system, also due to BaF, has been discovered in the near infra-red, and assigned to the transition $^2\Pi \rightarrow {}^2\Sigma$. AUTHOR.

447. Estimation of Metals in Solution by Means of their Spark Spectra. F. Twyman and C. S. Hitchen. *Roy. Soc., Proc.* 133. *pp.* 72–92, *Sept.* 1, 1931.—Records experiments undertaken to extend to liquids the accuracy of quantitative analysis recently attained by the spectrography of alloys. A method is given which shows how a spectrum may be produced from a solution which truly represents the solution, since the methods of Hartley and others are found unsuitable owing to incrustation of the electrodes and to decomposition of the solution around them. The effect of the presence of metals other than the one under determination is also considered. The method involves the use of a logarithmic sector and of an "internal standard," as introduced by Gerlach. Results are given for copper solutions ranging from 0·01 % to 1·00 %, the internal standard being cobalt, 1 %. Curves of zinc, bismuth, lead and certain mixtures are also given. H. L. B.

448. Nuclear Spin of Potassium. F. W. Loomis and R. W. Wood. *Phys. Rev.* 38. *pp.* 854–856, *Sept.* 1, 1931.—Photographs of certain bands in the absorption spectrum of the potassium molecule show branches with alternating intensities. Moreover, comparison of the line spacings with those calculated by extrapolating observations on lithium and sodium show that all lines of each branch are present and the phenomenon of alternating missing lines does not occur. This disproves the assertion, based on failure of certain observers to find hyperfine structure, that the nuclear spin of K^{39} is zero. AUTHORS.

449. Isotope Separation in the Spectra of LiI. D. S. Hughes. *Phys. Rev.* 38. *pp.* 857–861, *Sept.* 1, 1931.—Three lines of the LiI spectrum were examined for possible isotope components. A faint component was found on the long wave-length side of the lines 6708 Å. and 3232 Å. The measured separation of this component and the doublet is in good agreement with the calculated separation of the Li^6 and Li^7 lines. No components other than the regular doublet were observed for the line 6104 Å. This is in accord with the theory, since the calculated separation for this line is below the limit of resolution of the apparatus used. AUTHOR.

450. Intensity Changes of Hyperfine Structure Lines. H. Schüler and J. E. Keyston. *Zeits. f. Physik*, 71. 7–8. *pp.* 413–415 *Sept.* 3, 1931.—By varying the conditions of excitation in the same Schüler hollow kathode discharge tube, large changes of intensity of the hyperfine structure lines of Cd are produced. Similar intensity changes occur in the case of Tl and Hg hyperfine structures. These changes of intensity are not due to self-absorption and no explanation of them can be given. J. E. K.

451. Hyperfine Structures and Nuclear Moments. H. Schüler. *Phys. Zeits.* 32. *pp.* 667–670, *Sept.* 1, 1931.—After a short introduction the methods of determining the nuclear moment, I, of an atom are outlined. A table of the experimentally established values of I is given. Cd is of special interest; the even isotopes of Cd have $I = 0$ and the two odd, isotopes 111 and 113 have $I = \frac{1}{2}$ with inverted terms, the lower term levels having the larger values of F. The hyperfine structure of Li^+ is important on account of the simplicity of this atom and the excellent agreement between theory and experiment in this case. The TlII spectrum is remarkable in showing besides the hyperfine structure separation a relatively large isotope displacement effect. In the *Discussion*, **Kopfermann** gives results of experiments on Pb hyperfine structure. Thorium lead (208) and uranium lead (206) have $I = 0$. Pb^{207} has $I = \frac{1}{2}$. Pb^{206} and Pb^{208} show a large isotope displacement effect. **Jackson** reports that the Tl lines $\lambda5352$ and $\lambda3776$ both show the displacement effect discovered by Schüler and his measurements are in complete agreement with Schüler's. **Pauli** gives a short summary of the present status of hyperfine structure theory. Assumptions with satisfactory experimental support are: (1) The explanation of hyperfine structure by the introduction of a nuclear spin-vector, I. (2) The vector model for hyperfine structure and the intensity and selection rules. (3) The cosine law and the interval rule. (4) The equidistance of Zeeman separations. The outstanding difficulties are: (1) The rule for the calculation of separations; large discrepancies remain even after relativistic calculation. (2) The inversion of the Cd terms which cannot be explained either by the action of nuclear electrons or as a resonance effect between nuclear and external electrons. (3) The newly discovered isotope displacements. J. E. K.

452. Theory of Hyperfine Structure. G. Racah. *Zeits. f. Physik*, 71. 7–8. *pp.* 431–441, *Sept.* 3, 1931.—An investigation is made of some possible causes for the large discrepancies which exist in many cases between the experimental results and the theory of hyperfine structures. The relativity corrections are calculated and also the effects of possible irregularities of the nuclear electric field. The hyperfine structure separations are calculated for intermediate coupling in singlet-triplet spectra. An explanation of the experimental discrepancies is, however, not obtained. J. E. K.

453. Paschen-Back Effect of the Hyperfine Structure of Thallium II. J. B. Green and J. Wulff. *Zeits. f. Physik*, 71. 9–10. *pp.* 593–599, *Sept.* 19, 1931.—The Zeeman components of the λ3092 line of TlII are photographed for field strengths of 14,700, 32,500 and 43,350 gauss. The observed components agree in number, position and intensity with those calculated by the application of the theory of the Paschen-Back effect to hyperfine structures. J. E. K.

454. Hyperfine Structures in the First Spectra of Krypton and Xenon. C. J. Humphreys. *Bureau of Standards, J. of Research*, 7. *pp.* 453–463, *Sept.*, 1931.—The stronger arc lines of Kr and Xe are examined for hyperfine structures with a quartz Fabry-Perot etalon and quartz Lummer plates. The following lines possess measurable structures: Kr, 5570, 7685, 8059, 8104 and 8508 Å.; Xe, 4193, 4501, 4734, 8232, 8409 and 8819 Å. The observed complex lines in the two spectra are not spectroscopically analogous. No definite numerical regularities in the spacing of components, such as have been reported in the case of Ne, are observed. The hyperfine structure satellites of Ne lines are supposed to be due to the Ne^{22} isotope. Kr and Xe have six and nine isotopes respectively, and the fine structure might be expected to be more complicated. The relative abundance of the isotopes of odd atomic weight in Kr and Xe leads to consideration of the possibility that the observed satellites may be due to the nuclear moment of these odd isotopes. J. E. K.

455. Raman Effect in CO_2. E. Fermi. *Zeits. f. Physik*, 71. 3–4. *pp.* 250–259, *Aug.* 15, 1931.—From the linear model of CO_2 only one inactive frequency would be expected, giving only one strong Raman line. Actually two strong ones are observed, together with satellites. Of the three frequencies ν_1 (1230 cm.$^{-1}$), ν_2 (673 cm.$^{-1}$) and ν_3 (2350 cm.$^{-1}$), the last is too high to be concerned, since the two strong lines are of the order of 1300 cm.$^{-1}$. ν_1 is the inactive frequency, and can be expected to appear. $2\nu_2$ is 1346, and is of the same order as ν_1. A degeneration can occur in this case, which allows $2\nu_2$ to appear strongly. The same explanation holds good for CS_2, and probably for the appearance of two lines 758 and 789 cm.$^{-1}$ in CCl_4 where only one is expected. A. C. M.

456. Raman Effect in Rock-Salt. E. Fermi and F. Rasetti. *Zeits. f. Physik*, 71. 9–10. *pp.* 689–695, *Sept.* 19, 1931.—It has been found possible to obtain a Raman spectrum for rock-salt, but so weak that it is regarded as a second-order Raman effect. The symmetry of the rock-salt lattice precludes expectation of observing the lattice frequency corresponding to 52 μ. Excitation was by the mercury resonance line $\lambda 2537$ from a water-cooled arc, filtered through cold mercury vapour. The spectrum obtained was a continuous one, stretching to about 365 cm.$^{-1}$. It is shown that the spectrum to be expected is one stretching to twice the lattice frequency shift, so that the experimental result leads to a value 183 cm.$^{-1}$, *i.e.*, 55 μ. A. C. M.

457. Effect of Varying Concentrations of Electrolytes on the Violet Band of the Raman Spectra of Water. C. C. Hatley and D. Callihan. *Phys. Rev.* 38. *pp.* 909–913, *Sept.* 1, 1931.—A Hilger E-1 spectrograph was used to study the Raman scattering by pure water excited by the 3650 Å. group of the mercury arc. Photometric measurements of the plates were made with a Moll microphotometer. The violet band at about 4150 Å. appears to consist of three components. The effect on this band of various concentrations of aqueous solutions of KCl, NaOH, and KOH was examined. In all cases the energy appears to shift toward the long wave-length side and in addition the top of the curves grows sharper with increasing concentrations. AUTHORS.

458. Higher Order Stark Effects in the Balmer Lines of Hydrogen. K. Basu. *Indian Phys. Math., J.* 2. *pp.* 25–28, *Sept.*, 1931.—The theory previously developed [see Abstract 502 (1931)] is here applied to the Balmer lines and the expected values given for fields up to 10^6 volts per cm. F. S.

459. Attempts to Detect the Stark Effect in Band Spectra. B. Svensson. *Zeits. f. Physik*, 71. 7–8. *pp.* 450–452, *Sept.* 3, 1931.—An attempt is made, by the lo Surdo method, to detect the Stark effect in the four CO bands at 4835, 4511, 4393 and 4123 Å. Under the conditions of the experiment no resolution nor displacement of the bands could be detected. C. B. A.

460. Zeeman Effect in the Ortho-Helium Band Spectrum. J. S. Millis. *Phys. Rev.* 38. *pp.* 1148–1163, *Sept.* 15, 1931.—Resolved and partially resolved Zeeman patterns have been obtained at high dispersion for ortho-helium bands of the types $nd\delta$, ${}^3\Delta \rightarrow 2p\pi$, Π^3; $nd\pi$, ${}^3\Pi \rightarrow 2p\pi$, ${}^3\Pi$; and $nd\sigma$, ${}^3\Sigma \rightarrow 2p\pi$, ${}^3\Pi$. For small values of rotational energy, these patterns agree with the theoretical predictions for a case b' molecule. Departure from these predictions, which increases with n, K, and $l - \lambda$, is noted in all of the above bands. Patterns of some levels of large rotational energy approximate the predictions for a case d' molecule. This departure is in agreement with predictions and observations of the energy changes incident to the uncoupling of the orbital angular momentum of the excited electron from the molecular axis. Thus, the Zeeman effect affords a method of tracing the progress of this uncoupling phenomenon. Evidence is given that the line Q(9) of the band $4p\pi$, ${}^3\Pi^{(0)} \rightarrow 2s\sigma$, ${}^3\Sigma^{(0)}$ has a triplet structure without field. AUTHOR.

461. Zeeman Effect of Neon. K. Murakawa and T. Iwama. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, Nos.* 326–327. *pp.* 256–259, *Sept.*, 1931.—With an improved experimental arrangement the authors have re-measured the Zeeman effect of some Ne lines which they had previously investigated [see Abstract 3731 (1930)]. A term correlation is deduced which is in disagreement with Hund's theory. J. E. K.

462. Energy Relations in Complex Spectra. D. R. Inglis. *Phys. Rev.* 38. *pp.* 862–872, *Sept.* 1, 1931.—The manner in which the energy levels of extreme (*jj*) coupling are split up by interaction of the electrons is calculated, and the results serve in special cases to determine energies in the condition intermediate between (*jj*) and (LS) coupling. Single-electron wave functions appropriate to large spin-orbit interaction are selected, and antisymmetric atomic wave functions are formed of them. With these the diagonal elements of the matrix of electrostatic interaction are reduced to combinations of radial integrals, the same integrals met by Slater in (LS) coupling. Some configurations have only one such radial integral to express electrostatic interaction. It serves as a parameter in the extension to intermediate coupling by a method of Goudsmit. Coefficients in the general equation for the energies are determined by the energies in extreme couplings. Knowledge of electrostatic energies in (*jj*) coupling, as here calculated, extends the applicability of the method to configurations having three states with the same angular momentum.
AUTHOR.

463. Allowed Levels for Equivalent (s, p, d, f) Electrons with (jj) Coupling. S. D. Bryden, Jr. *Phys. Rev.* 38. *pp.* 1145–1147, *Sept.* 15 1931.—The allowed levels for equivalent (*s, p, d, f*) electrons, with (*jj*) coupling are given in tabular form. AUTHOR.

464. Propagation of Light in Non-Homogeneous Media. K. Försterling. *Ann. d. Physik,* 11. 1. *pp.* 1–39, *Sept.* 2, 1931.—Deals mathematically with the production of a reflected wave when " light " is propagated in media consisting of layers with steadily variable refractive index. The problem is of importance in connection with wireless telegraphy, and the results obtained explain reflection in the Heaviside layer. In this layer the refractive index varies for the electromagnetic waves involved, owing to the ionisation of the atmosphere. The occurrence of total reflection can be fairly easily explained by means of the general fundamental equations obtained by the author, and the modifications produced by a small amount of absorption in the medium can be dealt with. The general treatment of partial reflection is more difficult, but a partial explanation can be given. The reflected wave is built up of components, which are reflected from each layer of the substance, and work together at the observation point, the phase of each being taken into consideration. Rays which undergo multiple reflection between the layers are not considered. The process is evidently, in reality, very complicated.
H. N. A.

465. Combined Radiation of Certain Oxides. G. Liebmann. *Zeits. f. Physik,* 71. 7–8. *pp.* 416–421, *Sept.* 3, 1931.—Describes a simple apparatus with which the combined radiating powers of platinum, the Nernst mass, certain pure oxides and various mixtures of thorium oxide and cerium oxide have been determined, in relation to the temperature, by the radiation method. The effects of composition of the mixture and of size of grain have been investigated. Light has been thrown on the behaviour of the Auer mass, thorium oxide with about 1 % of cerium oxide. H. N. A.

466. Experimental Study of Magnetophotophoresis. E. Reeger. *Zeits. f. Physik,* 71. 9–10. *pp.* 646–657, *Sept.* 19, 1931.—A modified arrangement based on that of Ehrenhaft [see Abstracts 2560 and 3460 (1930)] and including a new micromagnet is described in detail. A notable difference has been observed with the apparatus in the behaviour of Fe and Sb particles as regards the reversibility of magnetophotophoresis. A definite relation has been established between the direction of an applied electric field and the direction of magnetophotophoresis. J. E.

467. Experimental Study of Electrophotophoresis. P. Selner. *Zeits. f. Physik,* 71. 9–10. *pp.* 658–665, *Sept.* 19, 1931.—The effect described by Ehrenhaft [see Abstracts 2560 and 3460 (1930)] has been studied with a number of different substances. Measurements on the relation between the field strength and the velocity of electrophotophoresis show an increase to a saturation value of the latter. J. E.

468. Dependence of Electrophotophoresis on the Intensity of Light and on the Gas Pressure. Erika Wilflinger. *Zeits. f. Physik,* 71. 9–10. *pp.* 666–677, *Sept.* 19, 1931.—In the region studied the electrophotophoretic work increases linearly with the light intensity but at a certain gas pressure grows to a maximum. The actual value of the field strength used appears to have no effect on the value of this maximum. The highest value for the photophoretic work is obtained at a different pressure from that of the electrophotophoretic work. J. E.

469. Reflection of X-Rays from Thin Films. E. Nähring. *Phys. Zeits.* 32. *pp.* 730–733, *Sept.* 15, 1931.—The relation between intensity of X-rays reflected from sputtered silver and platinum films and the angle of reflection is investigated. For small angles the reflecting power of thin films is greater than that of thicker ones. In determining X-ray refractive indices of metals by total reflection, care must be taken that the films are of sufficient thickness. The reflecting power of glass is diminished by bad polishing. C. B. A.

470. X-Ray Refractive Indices of Various Glasses. F. Jentzsch and E. Nähring. *Zeits. f. techn. Physik,* 12. 9. *pp.* 424–428, 1931.—A photographic and an ionometric method give concordant values for the refractive indices of 15 optical glasses at $\lambda = 1\cdot54$ Å. These agree with calculated values in two cases only, the others diverging as much as 66 %, with a mean deviation of 43 %, always in the same direction. No explanation of this has been found. C. B. A.

471. Origin of Lines in the Continuous X-Ray Spectrum. F. Vierheller. *Univ. Nac. La Plata, Estudio Ciencias.* 5. *No.* 93. *pp.* 349–376, *Sept.,* 1931.—In the continuous X-ray spectrum a large number of spectral lines are found, the origins of some of which may perhaps be explained as follows: In the immediate neighbourhood of the already determined characteristic rays of tungsten, others are found which agree with the Sommerfeld theory. The remaining spectral lines are not in agreement with the selective theory, but it is agreed that this theory does not hold for very intense electric fields. The spectral lines found are in good agreement with the calculated values. Three spectral lines of the group α have been determined, 5 of β, 2 of γ and finally 1 of the group δ, and they all appear to be related to the κ-radiation. In the field of radiation α, spectral lines have been observed in agreement with the theory of Wentzel. These spectral lines not only exist for the spectral line α_{22}, but also for those of α_{21}. A spectral line of the same class has been determined for the spectral line α_{11}. Sommerfeld has shown that the spectral lines emitted by a spark discharge have a certain relationship with the atomic number of the element of the antikathode. The differences are in direct relationship with Z. The author has determined, as far as the number $Z = 74$, from the existing measurements, that the roots of the differences are in direct proportion with the number of the order, assuming the spectral lines under consideration have not some other origin. This relationship holds rigorously for the differences. Other spectral lines may be identified in the neighbourhood of those of the α and β series, but it is not possible to classify these as spark radiation of a higher order. If such a new spectral line is observed at a certain distance from one of those already mentioned, then another spectral line is also observed at the same distance on the other side. Sometimes these spectral lines correspond to one of the series α or β, or with one of the spectral lines identified as due to the spark discharge. These symmetrically distributed spectral lines must be attributed to some other cause. Doubtless they arise from the diaphragm which the rays pass through before reaching the crystal. In a future paper results will be published investigating this question. B. J. L.

472. Simple Wave-Mechanical Theory of X-Ray Spectra. V. S. Vrkljan. *Zeits. f. Physik*, 71. 5–6. *pp.* 403–411, *Aug.* 29, 1931.—Taking into account the other electrons as well as the nucleus, Schrödinger's wave equation for an electron in an atom is written down. From the proper values of its wave function, the energy of the system comprising all the electrons is calculated. An expression for the frequency of X-ray lines is deduced. This agrees in form with Moseley's expression, but quantitative agreement cannot be tested. Certain difficulties and the question of magnetic splitting of the spectral lines are discussed. N. D.

473. K-Series of Copper and Iron. G. Ortner. *Akad. Wiss. Wien, Ber.* 140. 2*a*. 7. *pp.* 403–417, 1931.—A double crystal spectrometer is described which has been specially constructed for use with long wavelength X-rays. With this spectrometer the α_1, α_2 and β_1 lines of the K-series of iron and copper are investigated. It is found that only CuK_{α_1} shows a normal peak without any suggestion of fine-structure or asymmetry. All the other lines investigated show deviations from the normal. The asymmetry of the FeK_{α_1} and FeK_{α_2} peaks is very well marked. The CuK_{α_2} peak also shows asymmetry. From the preliminary measurements a fine-structure is very probable for the CuK_{β_1} and FeK_{β_1} peaks. J. T.

474. Fine Structure in the K-Absorption Edge of Potassium. G. A. Lindsay. *Zeits. f. Physik*, 71. 11–12. *pp.* 735–738, *Sept.* 26, 1931.—The K-absorption of potassium is measured by reflection from crystals of KCl, KBr and KI. The energy differences between the maxima and minima of the fine structure and the main edge are approximately inversely proportional to the squares of the lattice-constants. This is in agreement with Kronig's theory that the fine structure is determined by the geometrical arrangements of the lattice components. C. B. A.

475. Absorption Spectra of the M-Series of the Elements Bismuth, Lead, Thallium and Gold. P. Krafft. *Akad. Wiss. Wien, Ber.* 140. 2*a*. 7. *pp.* 605–614, 1931.—In addition to the wave-lengths of the absorption edges M_{V}, M_{IV} and M_{III}, already given by Lindberg and others, the author has found a more or less organised structure in almost all his records, which belongs to the absorption spectrum. He regards these edges as subsidiary ones, the Lindberg or principal edges being due to simple ionisation of the atom. These subsidiary edges are mostly on the long wave-length side of the principal edges. Those on the short wave-length side may be due to multiple ionisation. The others are more difficult to explain. They may be connected with the O level. H. N. A.

476. Satellites of M-Series X-Ray Lines. F. R. Hirsh, Jr. *Phys. Rev.* 38. *pp.* 914–924, *Sept.* 1, 1931.—Four satellites of the diagram line $M\alpha_1$ have been measured in the range of atomic numbers from U (92) to Yb (70). Two of these satellites have not been reported previously. Three satellites of the diagram line $M\beta$ have been measured in the range of atomic numbers from U (92) to Gd (64). Two of these satellites have not been reported previously. Superposition of the semi-Moseley graphs for the satellites of $M\alpha_1$ and $M\beta$, gives rise to the suggestion that perhaps both X-ray lines are modified by the same optical lines. All these observed satellites obey the "Moseley" law—the data giving a straight line within experimental error. The semi-Moseley graph of the satellite $M\beta^{ii}$ shows a significant break at atomic number 70. The satellites of $M\alpha_1$ vanish at Er (68), coincident with the splitting of the $M\alpha_1$ line into three components at this place, *i.e.*, at atomic number 68. The range of values of $\Delta\nu/R$, between satellite and parent line, is from 0·1 to 2·0, in agreement with the results of previous workers, for the satellites of K and of L series lines. A peculiar continuous spectrum accompanies the satellites of $M\alpha_1$ and $M\beta$ for the elements U (92) and Th (90). AUTHOR.

477. M-Series Absorption Spectrum of Tantalum. C. A. Whitmer. *Phys. Rev.* 38. *pp.* 1164–1169, *Sept.* 15, 1931.—The M-series absorption spectrum of tantalum (73) has been investigated, with a vacuum spectrograph of the Siegbahn type. The absorption screens were metallic tantalum, prepared by an evaporation process. Spectrograms were obtained for three absorption limits at 5·64 Å. (M_{III}), 6·773 Å. (M_{IV}), and 6·997 Å. (M_V). When the experimental ν/R values are compared to values calculated from L-absorption and emission data, the experimental values for M_{IV} and M_V show a displacement toward higher frequencies and the M_{III} limit a displacement toward lower frequencies. These discrepancies are in agreement with those found by several other investigators in the region from W (74) to Au (79). The M_{III} limit has the appearance of a white line, and M_{IV} and M_V are diffuse in character. The possibility of an explanation of these discrepancies on the basis of transitions to levels in the periphery of the atom is suggested. AUTHOR.

478. Dynamical Theory of X-Ray Interference. M. v. Laue. *Ergeb. d. exakten. Naturwiss.* 10. *pp.* 133–158, 1931.—While recognising Ewald's dynamical theory as a masterpiece of mathematical physics, the author has worked over the ground *ab initio*, and found many simplifications and corrections of Ewald's theory. The paper, which does not lend itself to abstracting, takes up successively the fundamental dynamical equations, the approximate solutions of these, the simplest examples for non-absorbing crystals, an investigation as to the reality of the dispersion-surface, and the reflection of X-rays at the boundaries of non-absorbing crystals. A. D.

479. X-Ray Diffraction in Liquids and Solutions. J. A. Prins. *Zeits. f. Physik*, 71. 7–8. *pp.* 445–449, *Sept.* 3, 1931.—In measurements of X-ray diffraction in liquids, the continuous spectrum is a disturbing factor. By means of a nickel filter and the use of voltages below 15 kV, copper radiation has been satisfactorily monochromatised, and the results of earlier work [see Abstract 207 (1930)] have either been revised (aliphatic compounds) or confirmed and extended (solutions). C. B. A.

480. Diffraction of X-Rays in Organic Mixtures. A. W. Meyer. *Phys. Rev.* 38. *pp.* 1083–1093, *Sept.* 15, 1931.—X-ray diffraction patterns for five mixtures of organic liquids show a single major peak, lying between those of the two constituents, the position of which moves non-linearly with the composition. In some cases, secondary peaks corresponding to the pure constituents are found, but they are also shifted. An emulsion showed major peaks corresponding to each constituent, the intensities depending on the relative concentrations. These results indicate that in a solution there exists a single type of cybotactic group, which contains molecules of both constituents, the length of the space periodicity in the group depending on concentrations, while the emulsion contains two types of cybotactic groups. A solution exists only when the components, instead of having individual space molecular groupings, form a single type of cybotactic group. Solutions are thus similar to crystals. C. B. A.

481. Dependence of Compton Line Breadth on Primary Wave-Length. J. W. M. DuMond and H. A. Kirkpatrick. *Phys. Rev.* 38. *pp.* 1094–1108, *Sept.* 15, 1931.—The breadth of a Compton line should be nearly proportional to the primary wave-length. This is confirmed by experiments in which the K-radiation of Mo, Ag and W was scattered from graphite at an angle of 156°, the scattered radiation being analysed by a multi-crystal spectrograph. The Compton line can be thought of as broadened by the Doppler effect of the motion of the scattering electrons, and a simplified theory of this is given. [See also Abstract 3499 (1931).] C. B. A.

482. Electron Reflection in Metal X-Ray Tubes with Hollow Anodes and Kathodes. H. Seemann and K. F. Schotzky. *Zeits. f. Physik*, 71. 1–2. *pp.* 1–25, *Aug.* 4, 1931.—In glass X-ray tubes the distribution of the electric field is variable on account of the charge upon and currents towards the surface of the walls. In tubes with metal walls, the electric fields can be made definite and the distribution of the electron current in such cases is investigated by using catch-plates of various shapes, arranged to intercept part of the current. In tubes with hollow anodes, about 50 % of the incident electrons are reflected from the focal spot, *i.e.*, about the same proportion as in glass-walled tubes. Thus, about 40 % of the incident energy is reflected. In tubes with hollow kathodes only 30 % of the incident energy is reflected. Photographs of focal spots taken with a pinhole camera are used to illustrate the results. A theory of the various effects is given. N. D.

483. Control and Self-Rectification of Gas X-Ray Tubes. W. Band. *Journ. Sci. Instruments*, 8. *pp.* 247–250, *Aug.*, 1931.—This paper describes a new X-ray tube anti-kathode designed to improve the stability and rectifying efficiency of gas tubes of the clamped electrode variety. Methods of increasing the control of such tubes are discussed. Tests on a tube actually made to this design show that steady currents up to 15 mA can be used; and the rectifying efficiency is fairly constant under working conditions, between 60 % and 70 % for the ratio d.c./a.c.

AUTHOR.

RADIOACTIVITY.

484. Determination of the Age of Uranium Minerals by the Lead Method. F. Hecht. *Akad. Wiss. Wien, Ber.* 140. *2a*. 7. *pp*. **599–603, 1931.**—The author has made a series of analyses of individual crystals of Morogoro ore, in some cases dividing the crystal into different layers. His results show that great care is necessary in making conclusions as to the age of the specimen from the ratio of the amount of radio-lead, RaG, to U + 0·25 Th found in the analysis. This ratio varies very greatly in the different layers of the same crystal, owing to weathering. H. N. A.

485. Radioactivity of Rocks from the Pitchblende Mining District of St. Joachimsthal. F. Běhounek and W. Santholzer. *Gerlands Beitr. z. Geophys.* (*Köppen Band*, 2.) 33. *pp*. **60–69, 1931.**—Determined in a simple and rapid manner by melting samples and passing the evolved gases into an ionisation chamber (apparatus, which is of iron and brass, is described in detail), the radioactivities of 20 samples of rocks from this neighbourhood are (in units of 10^{-12} gm. radium): crystalline schists (5) 17–293; eruptive rocks, on or near the surface (3) 1·8–13, deep (5) 11–63; vein fillings, dolomite (4) 3·2–79, fluorite (1) 10; other rocks (2) 2·0–16·3. C. A. S.

486. Nature of "Radio-Colloids." O. Werner. *Zeits. f. phys. Chem.* 156. *Abt. A*. 2. *pp*. 89–112, *Sept.*, **1931.**—The appearance of groups detectable by Chamié's photographic method [see Abstract 2508 (1929)] is not general for all radio-elements, but depends on the chemical type of these elements, the determining factor being apparently the possibility of the formation of sparingly soluble compounds, *e.g.*, by hydrolysis. With ThB and ThC, but not with ThX, occurrence in colloidal form is observable. Addition of acids, of certain neutral salts, *e.g.*, sodium chloride, or organic substances such as mannitol, causes the group-formation to disappear. Experiments on the system ThB-ThC in aqueous solution with the help of the centrifuge method show that, in the formation of radio-colloids great importance attaches to the presence of adsorption centres formed owing to the unavoidable presence of impurities. The adsorption may be influenced in any desired way by positive or negative charging of the adsorbent by adding acids, bases, or salts. In aqueous solution ThB and ThC emit oppositely charged ions, adsorption of which by the carrier substances simulates colloid formation; ThB behaves as kation and ThC mainly as anion. In aqueous or acid solution the presence of molecular, undissociated products of hydrolysis is improbable, but with faintly alkaline solutions the presence of molecular $Bi(OH)_3$ must be considered. In dilute solutions of electrolytes the influence of the charge of adsorbent and adsorptive predominates; only in the more concentrated solutions is the influence of the sparing solubility of the adsorptive felt. T. H. P.

487. Laws of Separation of Very Small Amounts of Substances during the Formation of Mixed Crystals. R. Mumbrauer. *Zeits. f. phys. Chem.* 156. *Abt. A*. 2. *pp*. 113–134, *Sept.*, **1931.**—The results of experiments with solutions of barium and radium salts show that, during slow crystallisation from supersaturated solution, the distribution of the microscopic (radioactive) components between crystal and solution corresponds with the Nernst–Berthelot distribution law, and in the crystal is homogeneous. Rapid separation from supersaturated solution follows a logarithmic law of distribution, accumulation of the radioactive components being greater in the inner than in the outer portions of the crystal. The results of Chlopin, Polessitsky and Tolmatscheff [see Abstract 2848 (1930)] are explainable in the light of the above considerations. T. H. P.

488. Indefinite Metal-Solution Potentials and their Use for the Electrochemical Separation of Radio-Elements. O. Erbacher. *Zeits. f. phys. Chem.* 156, *Abt. A.* 2. *pp.* 135–141, *Sept.*, 1931.—The indefinite potentials of certain metals towards 0·1 *N* HCl have been determined at 20° and 79° under conditions corresponding with those of the electrochemical separation of polonium on silver and of radium E on nickel. Comparison of the metal-solution potentials with the separation potentials of dissolved radio-elements at 20° gives an indication of the electrochemical relationships in the electrochemical processes of radiochemistry. It is shown, *inter alia*, that failure of the electrochemical deposition of the radioactive isotopes of bismuth (radium E and thorium C) on nickel at 20° rests on the potential relationships. T. H. P.

489. Novel Electrochemical Process of Radiochemistry. O. Erbacher. *Zeits. f. phys. Chem.* 156. *Abt. A.* 2. *pp.* 142–149, *Sept.*, 1931.—A description is given of a simple procedure which allows of the electrochemical separation from solution of polonium and of the radioactive isotopes of bismuth (radium E and thorium C) on platinum charged with hydrogen. This procedure, which, as regards the purity of the preparations obtained and the completeness of the separation, corresponds with electrochemical depositions on silver or nickel, has the great advantage of yielding solutions of the radio-elements named free from inactive salts by merely dissolving in acid. T. H. P.

490. Determination of the Number of α-Particles Emitted by a Gramme of Radium in One Second. R. Dettelmaier. *Akad. Wiss. Wien, Ber.* 140. 2*a*. 5–6. *pp.* 347–351, 1931.—The measurements were carried out with strong preparations of polonium. It has been found that the method devised by G. Ortner, in which the charge carried by the emitted α-particles is measured, gives more reliable results than those obtained by the ionisation method. Using the equilibrium relation between the masses of radium and polonium it is calculated that approximately $Z = 3 \cdot 7 \times 10^{10}$ atoms of radium disintegrate per sec. from 1 gm. of radium. H. N. A.

491. Chemical Effects of α-Rays. W. Mund. *Ann. Soc. Sci. de Bruxelles,* 51. *pp.* 128–147, *Aug.* 8, 1931.—Deals mainly with the theory advanced by Lind (1928) that ions before recombination collect other neutral molecules into clusters which are caused to react at the time of electrical neutralisation. The author maintains that there are certain chemical reactions possible within the cluster itself, owing to particular conditions of temperature and pressure. He quotes observations on the action of α-particles on gases like N_2O and H_2S in support. E. E. F. d'A.

492. Fatigue of Zinc Sulphide Phosphors under α-Rays. P. M. Wolf and N. Riehl. *Ann. d. Physik,* 11. 1. *pp.* 103–112, *Sept.* 2, 1931.—Rutherford has interpreted the fatigue of ZnS phosphors under α-rays as due to the destruction of the centres [see Abstract 77 (1911)]. This work on a number of ZnS phosphors shows that this idea needs revision. The rate of fatigue is independent of the origin or method of preparation of the phosphor, and absolutely dry specimens show no fatigue under β-ray or γ-ray bombardment. Measurements on the fatigue and on the efficiency of the scintillation process indicate that the destruction of a centre has nothing to do with the emission of light, and that a centre can be excited to light emission many times by α-particles. It is concluded that the mechanism of light emission is the same under light stimulation as under α-rays. J. E.

493. Theory of Radioactive α-Disintegration. Nuclear Disruption and Excitation by α-Rays. G. Gamow. *Phys. Zeits.* 32. *pp.* 651–655, *Sept.* 1, 1931.—Considers the theory of normal α-disintegration, and concludes that the agreement of the theory with experiments in the three radioactive families is satisfactory. Also deals with long-range α-particles, with special reference to ThC′ and RaC′; the plausible explanation given of the connection between the α- and γ-rays is, as Lise Meitner points out, to some extent invalidated by the fact that there is no γ-line spectrum at all in the case of ThC, and no corresponding secondary electrons. The fine structure of the α-rays is dealt with, and nuclear radii of the excited states are calculated. Gives explanations of the disintegration of light nuclei by collisions with α-particles, with and without the capture of the α-particle. In both cases the protons emitted are divided into two groups. In the first there is a continuous energy spectrum, the maximum of which is smaller than the energy of the incident α-particle. In the other group there is a line spectrum, the energy of which is in some cases larger and in others smaller than that of the α-particle. This and other peculiarities are accounted for by the theory. H. N. A.

494. Theory of Anomalous Scattering of α-Particles by Light Nuclei. E. Guth and T. Sexl. *Phys. Zeits.* 32. *pp.* 655–659, *Sept.* 1, 1931.—Classical theory fails to account for the anomalous scattering, and the same is true of the wave-mechanical theory, using Born's collision method, since the perturbation method cannot be employed. The authors sketch a wave-mechanical theory in which the perturbation method is avoided. It is founded on the Gordon, Mott theory of scattering of charged particles in a Coulomb field, using polar co-ordinates; or the theory of the diffraction of light by small spheres (Mie, Debye). No parabolic coordinates are employed, but the so-called method of particular solutions, resolution by means of spherical waves, is used, as was done by Gordon. A preliminary comparison is made between the results of the theory and the known facts with regard to the scattering of α-particles by Al. The agreement is in some respects fairly satisfactory, and it is hoped that it will prove possible to extend the theory to H and He, also to polarisation, disintegration and excitation. H. N. A.

495. Forced Nuclear Processes. W. Bothe. *Phys. Zeits.* 32. *pp.* 661–662, *Sept.* 1, 1931.—Discusses the three homogeneous H groups I, II and III produced when boron is bombarded by α-particles. Groups II and III appear to be due to the isotope B^{10}, the α-particle being captured and C^{13} being formed ($B^{10} + \alpha - H = C^{13}$). With group II the C^{13} nucleus is excited, the excitation energy being equal to the energy difference between Groups II and III. Group I of boron may result from the process ($B^{11} + \alpha - H - \beta = N^{14}$). Deals also with the γ-radiation resulting from the collision of α-particles with nuclei. A diagram shows the number of γ-rays per million α-particles for the lighter elements, and also indicates whether disintegration takes place or not in each of them. Disintegration and excitation with subsequent emission of a γ-ray do not run parallel with each other; Be gives the largest γ-radiation, but has not been disintegrated; N, on the other hand, disintegrates, but gives no γ-rays, while B disintegrates and gives some γ-rays. The energy relations are considered in different cases. H. N. A.

496. Photography of Artificial Disintegration Tracks. P. M. S. Blackett. *Phys. Zeits.* 32. *p.* 663; *Disc.*, 663–665, *Sept.* 1, 1931.—A special Wilson cloud chamber is constructed so that four photographs per minute are automatically taken, each plate containing 50 tracks. Out of 750,000 tracks observed with A, none show disintegration, and out of 250,000 tracks with N, two. Up to the present the author has obtained 12 photographs showing disintegrations of N nuclei. From these the heat of formation of the O^{17} nucleus is calculated and found to be $-1\cdot39 \times 10^{6}$ volts. Special interest is attached to one of the latest photographs, which shows an α-particle which has a residual range of 2·5 cm. after a collision, the ejected proton having a range of 3·5 cm. In the *Discussion*, **Joliot** pointed out that the m.f.p. of the recoil rays of He, N, O, A, produced by α-particles is much greater than classical kinetic theory predicts. **Pauli** suggested that a direct test of the momentum law by investigating the recoil during a β-disintegration of a single nucleus is urgently required, but the experimental difficulties are too great. **Joliot** then discussed difficulties in connection with photography of α-recoils. In the cases of α-disintegration of radioactive An and AcA nuclei photographed by the Wilson method, he obtains, when the recoil ray makes an angle with the α-ray, a third track coming from the same point. All three tracks are shown to be coplanar. Theories of the nature of the third track are discussed. It would seem to be due either to associations of water vapour molecules, or of radioactive molecules, or to the splitting of the radioactive nucleus into two parts of large mass, but difficulties are attached to each theory. N. D.

497. Fading Effect Produced by Becquerel and Kathode Rays on Sodium Chloride. H. Pauli. *Akad. Wiss. Wien, Ber.* 140. 2*a*. 5–6. *pp.* 321–346, 1931.—Change of light absorption with time produced by β-γ radiation of sodium chloride, crystallised from its melt, has been investigated for seven different wave-lengths over a period of fourteen days. Quantitative decolorations were also carried out in the dark and at different temperatures. It was found that the data fit in with van't Hoff's law of reaction-velocity. $\ln\delta = -C/T + B$, C having almost the same value as for natural rock-salt. A thermal blue surface layer was not obtained either with prepared or slightly tempered natural salt.

H. H. Ho.

498. Nuclear Deflections of β-Rays. J. M. Nuttall and H. S. Barlow. *Manchester Lit. and Phil. Soc., Mem.* 74. *pp.* 35–40, 1929–1930.—The numbers of tracks of β-rays (227 in oxygen and 561 and 537 in nitrogen of initial energies of 22130, 19700 and 22240 volts respectively) showing nuclear deflections in the first $\frac{3}{4}$ths. of their range exceeding angles of (*a*) 50°, and (*b*) 90° have been determined by the author's stereoscopic method. Results for (*a*) are in conformity with Rutherford's theory; those for (*b*) confirm the formula given previously [see Abstract 1047 (1927)], giving atomic numbers 8·1 and 7·8 for O and N respectively. C. A. S.

499. Soft γ-Radiation of the Active Deposit of Thorium. R. Arnoult. *Ann. de Physique,* 16. *pp.* 196–207, *Sept.,* 1931.—The absorption of γ-radiation of ThB + C″, as emitted by the active deposit of thorium five hours after deposition on supports of nickel, copper and gold, was determined by means of aluminium screens and a gold leaf electroscope in an atmosphere of carbon dioxide, which eliminates corpuscular radiation. Analysis of (log. of ionisation current)/(mass per cm.^{2} of absorbing screen) curves shows the presence of radiation of $(\mu/\rho)_{Al} = 0·035$ (from ThC″), 0·105, 12·9 and 60 (from ThB), and 890 (from ThC), the energies of emission being respectively 2088, 319, 184, 109, and 98 × 10^{-4} from a source of 10,000 e.s.u. Other radiation observed was due to the support. The wave-lengths and numbers of quanta (× 10^{-4}) of radiation of $(\mu/\rho)_{Al} = 12·9$, 60 and 890 are respectively 0·970 Å., 7620; 1·638 Å. 1420; and 4·300 Å., 24190. [See also Abstracts 487 (1914) and 1938 (1931).] C. A. S.

500. Possibility of Influencing the Velocity of Radioactive Disintegration by Means of γ-Rays. O. Reinkober. *Zeits. f. Physik,* 71. 7–8. *pp.* 460–464, *Sept.* 3, 1931.—Pokrowski has recently suggested the possibility of such an influence. The author's experiments, however, show that nothing of the kind can be observed which is greater than the limits of uncertainty of the measurements, or about ± 1 %. H. N. A.

501. Properties of Natural H-Particles. C. Pawlowski. *Ann. de Physique,* 16. *pp.* 150–195, *Sept.,* 1931.—With polonium as source of α-particles and varying their range, R_{α}, by passage through varying thicknesses of air and/or carbon dioxide and mica, the number, n_H, and range, R_H, of H-particles produced in hydrogen, paraffin, cellophane, and collodion have been determined by the scintillation, Wilson's (with alcohol vapour), and Geiger counter methods. Chadwick and Bieler's previous results [see Abstract 920 (1922)] are confirmed, as also theory as to the maximum range being 4·1 R_{α}; but not as regards the relation between n_H and the velocity of the α-particles, the number varying almost directly, instead of inversely as the velocity. This number depends on the manner of production, *e.g.*, thickness of layer producing, and method of observation of the H-particles. Canalised α-particles yield only about half as many as uncanalised. Using different materials as a source of H-particles results depend solely on the content of hydrogen. C. A. S.

502. Magnetic Spectrograph for Feebly Radioactive Substances. G. Occhialini. *Accad. Lincei., Atti,* 14. *pp.* 103–107, *Aug.,* 1931.—The apparatus consists of a wide cylinder on the inner surface of which the active substance is mounted. The cylinder can be exhausted to a convenient extent. At its centre is mounted a small Geiger-Müller counter, and the whole is mounted on the pole-pieces of an electromagnet giving a vertical field. The field is increased until the radius of curvature of the rays is half the radius of the cylinder. E. E. F. d'A.

HEAT.

503. Thermal Conductivity and Its Temperature Variation for Medium Conductors. C. R. Ensor. *Phys. Soc., Proc.* 43. *pp.* 581–591, *Sept.*, 1931.—A plate method for the determination of thermal conductivity and its variation with temperature between 0° and 100° C. is described. Although specially adapted for medium conductors (of the order 0·001 to 0·02 c.g.s. units) such as rocks, it can be used for substances of lower conductivity. AUTHOR.

504. Simple Black Body. G. Liebmann. *Zeits. f. techn. Physik*, 12. 9. *pp.* 433–435, 1931.—On a purely theoretical basis a suggestion for the simple construction of a black body is evolved. The blackness of a slit in a hot tube is discussed in relationship to the size of the slit and the dimensions of the tube. The detailed description of the tube shows it to be a metal cylinder provided with water-cooling outer chamber, platinum-rhodium thermocouple, and the heating element of platinum embedded in a highly refractory material which acted as the source of illumination. The highest temperature reached was 1820° Absolute. The apparatus is claimed to afford a black body source of simple construction for spectrographic work. S. G. B.

505. Heating of Wood Coated with Various Paints. C. Dorno. *Gerlands Beitr. z. Geophys.* (*Köppen Band*, 1), 32. *pp.* 15–24, 1931.—Describes experiments to measure the effect of solar radiation in heating wooden specimens above the air temperature, these specimens being painted with three coats each of various pigments. The meteorological conditions during the experiments are carefully recorded. J. H. A.

506. Automatic Compensation Micro-Calorimeter. L. Algera. *K. Akad. Amsterdam, Proc.* 34. 6. *pp.* 906–917, 1931.—The apparatus is one in which small heat evolutions may be measured and their variations with time may also be followed. Its principle is to include in the calorimeter, besides the heat generating body, a small supply of water through which air may be bubbled, so as to evaporate some of the liquid and thus carry off latent heat. By balancing the two effects, the temperature is kept steady, so that heat capacities need not be known, and the reaction takes place isothermally. The quantity of heat evolved is measured by the amount of cooling produced, which is in turn proportional to the quantity of air bubbled through the water. To make the instrument truly automatic, there is a pump provided for the air stream, and it is stopped or started through the agency of a relay controlled by a thermocouple in the calorimeter. Thus the temperature is automatically maintained constant, whilst the heat evolution is obtained by calculation from the number of strokes made by the pump. The instrument is calibrated by generating heat electrically in the calorimeter. J. H. A.

507. Triple Points of Nitrogen and Oxygen as Fixed Points of the Temperature Scale. E. Justi. *Ann. d. Physik.* 10. 8. *pp.* 983–992, *Aug.* 24, 1931.—*From the Reichsanstalt.*—Earlier determinations from various authors are discussed at some length, and the necessary precautions brought to light. The result of the present work is to give the triple point for oxygen as 54·24 ± 0·04° K. under a pressure 1·20 ± 0·05 mm. Hg, the figures for nitrogen being 63·09 ± 0·01° K. and pressure 93·91 ± 0·05 mm. Hg. J. H. A.

508. Intercomparison of the High Temperature Scale. W. E. Forsythe. *Phys. Rev.* 38. *pp.* 1247–1253, *Sept.* 15, 1931.—This paper gives results on an intercomparison of the high temperature scales in use at the Physikalisch-Technische Reichsanstalt in Berlin, the Laboratoire Central in Paris, the Laboratory of the Philips Glowlampworks in Eindhoven, and the Laboratory of the Osram Lamp Company at Berlin with that in use in the Laboratory at Nela Park. For purpose of comparison the results of a previous intercomparison with the Bureau of Standards, the National Physical Laboratory at London, the General Electric Research Laboratory at Schenectady, and the Physical Laboratory at the University of Wisconsin are included. Several tungsten lamps that had been carefully aged and calibrated were sent to each of the foregoing laboratories and the temperatures of the lamps were measured for specified currents with a disappearing filament optical pyrometer using red glass as the monochromatic screen. The reductions necessary to make the readings comparable because a non-black body was used are pointed out. Results of the first and the final intercomparison given. Very good agreement was found in this intercomparison, the maximum difference being only a few degrees for any point of the entire range from about 1400° to 2700° K.
AUTHOR.

509. Fusion under Pressure, with Consideration of the Value of Interpolation Formulæ. E. Jänecke. *Zeits. f. phys. Chem.* 156. *Abt.A.* 3. *pp.* 161–175, *Sept.*, 1931.—The paper in the first place calls attention to the work of van Laar on equations of state, and in particular to his conclusion that the melting point can only rise to a certain finite limit, however great the increase of pressure. This temperature is above the triple-point, in the usual case of the solid being denser than the liquid. It being impossible to represent the observations with an explicit formula, they may be treated with the help of an interpolation formula of the type $(p + a)^r(b - t) = c$, where a, b, c and r are constants, whilst p and t are the pressure and the corresponding melting point. If $r = 1$, this gives a rectangular hyperbola as the curve. Either form agrees well with observations, but the inclusion of r is preferable because it can be made to fall into line with experimental results on the volume change at fusion.
J. H. A.

510. New Ebullioscopic Method for the Study of Ternary Heteroazeotropes. W. Swietoslawski. *Comptes Rendus,* 193. *pp.* 448–489, *Sept.* 28, 1931.—The third component is added to a mixture of the other components until the difference between the boiling point of the mixture and of the distillate falls to zero; by repeating this procedure with a second binary mixture, two points, R and P, on the boundary of the heterogeneous area and on a straight line passing through the azeotropic point are obtained. The composition of the mixtures R and P are then determined by mixing binary solutions, defined by the points of intersection of the straight line with the sides of the triangle, until turbulence appears. By distilling a mixture of the liquids of compositions defined by R and P, and observing the relative volumes of the two phases which distil at the minimum temperature, the composition of the heteroazeotropic mixture may be calculated. H. F. G.

511. Cryoscopic Constant, Heat of Fusion, and Heat Capacity of Camphor. M. Frandsen. *Bureau of Standards, J. of Research,* 7. *pp.* 477–483, *Sept.*, 1931.—In order to determine the cryoscopic constant of camphor the latent heat of fusion of this substance was measured calorimetrically. Values for the heat capacities of solid and liquid camphor were obtained at the same time. The determinations were made on synthetic camphor, the freezing point of which was found to be 178·43° C. Two samples of this material and one of pure silver, serving as a reference substance, were sealed in evacuated, thin-walled glass tubes, and successively heated to constant, well-defined temperatures in a narrow glass tube surrounded by the vapours of various liquids, boiling in the range from 20° to 212° C. In each case the heat content of the sample was measured by transferring it to a silvered Dewar tube, containing about 300 gm. of water. From a plot of the heat content against the temperature the following results were obtained: The latent heat of fusion at 178·4° C., $l_F = 10 \cdot 74 \pm 0 \cdot 40$, $\text{cal}_{15} g^{-1}$, or, $L_F = 1630 \pm 60$, $\text{cal}_{15}\ \text{mole}^{-1}$. The cryoscopic constant, $k_F = 37 \cdot 7 \pm 1 \cdot 4°$ C. mole^{-1} kg. The heat capacity of crystalline camphor in the range from 20 to 178·4° C., $c_{(\text{solid})} = (0 \cdot 4208 + 0 \cdot 000215t) \pm 0 \cdot 0035$, $\text{cal}_{15} g^{-1} {}^{\circ}\text{C.}^{-1}$, or, $C_{(\text{solid})} = (64 \cdot 0 + 0 \cdot 033t) \pm 0 \cdot 5$, $\text{cal}_{15}\ \text{mole}^{-1} {}^{\circ}\text{C.}^{-1}$. The heat capacity of liquid camphor in the range from 178·4° to 210° C., $c_{(\text{liquid})} = 0 \cdot 571 \pm 0 \cdot 045$, $\text{cal}_{15} g^{-1} {}^{\circ}\text{C.}^{-1}$, or, $C_{(\text{liquid})} = 87 \pm 7\ \text{cal}_{15}\ \text{mole}^{-1} {}^{\circ}\text{C.}^{-1}$. AUTHOR.

512. Low Temperature Rotational Heat Capacities and the Relative Amounts of the Nuclear Singlet, Triplet and Quintet Symmetry Modifications of Methane. D. S. Villars and G. Schultze. *Phys. Rev.* 38. *pp.* 998–1010, *Sept.* 1, 1931.—There should be three noncombining varieties of methane, the nuclear singlet, triplet and quintet, and two of ammonia, the nuclear doublet and quadruplet, just as there are two of hydrogen, the nuclear singlet and triplet (" para " and " ortho " hydrogen). In this paper the statistical weights of the rotational states have been evaluated and used in conjunction with the Raman spectra data to calculate the heat capacities of each separate variety of methane, of the true equilibrium mixture and of the " frozen equilibrium " mixture. The feasibility of demonstrating experimentally the existence of these different varieties of methane is discussed in the light of the present calculations. AUTHORS.

513. Measurement of Total Heat of a Liquid by the Continuous Mixture Method. H. R. Lang. *Phys. Soc., Proc.* 43. *pp.* 572–580, *Sept.*, 1931.—A development of Callendar's continuous-mixture method for the measurement of the total heat or specific heat of a liquid is given. It consists of the determination of the amount of heat extracted by a stream of water from a hot stream of the liquid. A discussion of the heat losses and the method of reducing and allowing for these is included, as well as experimental tests of the theory of the method. AUTHOR.

514. Total and Specific Heat of a Series of Fractions of Petroleum Oil, and Relation to other Properties. Part VI. H. R. Lang and R. Jessel. *Inst. Petroleum Technologists, J.* 17. *pp.* 572–584, *Sept.*, 1931.—The work is a continuation of that previously described [see Abstract 1321 (1931)] and deals with Persian oil fractions. Five fractions were studied, and the specific and total heats determined. As with other oils, the specific heat curve is practically linear, except for the higher boiling fraction in the neighbourhood of 0° C. The linear relations between specific gravity, mean molecular weight, refractive index and coefficient of expansion are still found to hold. J. H. A.

515. Specific Heats of Iridium and Ruthenium between 0° and 1604° C. and Comparison of Elements of the Eighth Group of the Periodic System. F. M. Jaeger and E. Rosenbohm. *K. Akad. Amsterdam, Proc.* 34. 6. *pp.* 808–822, 1931. *In English.*—The authors use the new and improved form of their apparatus [see Abstract 1961 (1931)]. For iridium (as for Os and Pt) C_p is a linear function of temperature and, when reduced to C_v by the thermodynamic formula, amounts to 8 cal. per gm. atom at 1700° C., the $C_p - C_v$ correction being only 4 % at this temperature. In order to obtain reproducible results a preliminary annealing at high temperature is necessary. There appear to be four allotropic modifications of ruthenium, the transition temperatures being at about 1035°, 1200° and 1500° C., and C_p is different in the various phases. The data for Os, Ir and Pt are compared in the light of the periodic table with those for Fe, Co and Ni, and for Ru, Rh and Pd. L. G. C.

516. Ternary System Carbon Monoxide-Nitrogen-Hydrogen. T. T. H. Verschoyle. *Roy. Soc., Phil. Trans.* 230. *pp.* 189–220, *July* 14, 1931.—A knowledge of the equilibrium data for this system is of value in the technical production of hydrogen at low temperatures. The investigation is carried out with apparatus of a usual type, modified in most cases so as to permit samples of the coexisting phases to be removed and analysed; and this was found far more practicable than the volumetric method, which was at first employed. For CO and for N the triple points and the melting-point curve for pressures up to 205 atmospheres, and for CO alone, the vapour pressures below two atmospheres are recorded. For the binary system CO–N, the freezing-point curve, and the liquid branches of the isothermals − 193·9° C., − 198·13° C., − 203·07° C. are found. For the binary system CO–H, the isothermals at − 185°, − 190°, − 200°, − 205°, − 210° C., and the three-phase curve are given, pressures ranging up to 225 atmospheres. The plait-point at − 185° C. lies at 187·5 atmospheres, and the mixture contains 42 % CO. For other temperatures a list of values is given. For the binary system N–H, similar data are provided. Finally, the equilibria in the ternary system CO–N–H are investigated at 30, 90, and 150 atmospheres, and − 185° C., − 195° C., and − 205° C. The results are fully illustrated by diagrams. J. P. A.

517. New Method of Measuring Temperature of Gases: Application to the Determination of Specific Heat at High Temperature. M. Chopin. *Ann. de Physique,* 16. *pp.* 101–149, *Sept.,* 1931.—The method depends on the relation between the weight of gas passing through a small orifice (*e.g.*, in platinum foil, coefficient of linear expansion α), the area of the orifice, the pressure on each side thereof, and the temperature [see Abstract 3059 (1928)]. To eliminate difficultly ascertainable quantities two orifices are used with means of heating the gas between them, and two experiments are carried out, the first without, the second with heating the gas. If T_1, T_3 are the temperatures at, and p_1, p_3 the differences between the pressures on the two sides of, the first orifice in the first and second experiments respectively, and T_2, T_4, p_2, p_4 the corresponding quantities at the second orifice, and θ the temperature of the platinum foil of the second orifice, $T_4 = T_3(1 + \alpha\theta)^4 p_1 T_2 p_4 / p_2 T_1 p_3$. The apparatus used, the methods of eliminating the numerous causes of error, and of adaptation to specific heat determination, are described in detail, the determinations being probably accurate to 1 %. The results for nitrogen (containing the inert gases and 0·15 % oxygen) are those previously given [see Abstract 3595 (1929)]; for carbon dioxide corrected figures are: at 200°, 9·80; 400°, 10·52; 600°, 11·03; 800°, 11·45; 1000°, 11·83; or generally $c_p = 8{\cdot}9 + 0{\cdot}62(t/100)^{0{\cdot}68}$, which gives results agreeing within 1 % with those of Nernst and Wohl [see Abstract 1923 (1930)]. C. A. S.

518. Friction, Heat Conductivity and Diffusion in Gaseous Mixtures. Part XIX. Temperature Coefficient Deduction for Gaseous Friction, from Chemical Formulæ and Critical Temperature. M. Trautz. *Ann. d. Physik*, 11. 2. *pp.* 190–226, *Sept.* 11, 1931.—A lengthy theoretical dissertation on the temperature dependent characteristics of an ideal gas, and their relationship to the chemical nature and structure. It is established that without exception, the relationship $m = d \log \eta / d \log T = 1$ for $T = T_k$ is valid. The conclusion is developed that T_k for all ideal gases is the mid-point of the isomeric equilibrium between the $T = 0$ form and the high temperature form, *i.e.*, the point where both forms exist in equal quantities. The value of the high-temperature form is not in general, as usually stated classically, proportional to $\sqrt{T}$, but experimentally it is shown that for gases containing a small number of atoms, the proportionality is to an intermediate value between T and $\sqrt{T}$. H_2O, HCN, NH_3 give high values, whilst He and H give low values. The limiting value is at $\sqrt{T}$, so that for highly numbered atomic gases the limit $T^{\frac{1}{2}}$ is closely approximated. The index $\frac{1}{2}$ is therefore designated the "minimum limiting exponent." The relationship of the coefficient of friction is discussed further for rare gases and mixtures of gases, and finally the Sutherland constant, etc., is studied in the light of the data established. S. G. B.

519. Isothermal and Adiabatic Compressibilities, Specific Heat and Heat Conductivity of Liquids. H. Shiba. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 325. *pp.* 205–241, *Sept.*, 1931.—The compressibilities were obtained from piezometer measurements, lowering the pressure from about 2 atmospheres to 1 atmosphere. The adiabatic elasticity follows from the instantaneous values of pressure and volume, and the isothermal from the steady readings ultimately obtained. The apparatus was immersed in a thermostat. Twenty-nine substances were examined, including CS_2, $CHCl_3$, CCl_4 benzene, toluene and a number of alcohols and esters. The specific heat is deduced thermodynamically from the ratio of elasticities, together with the known densities and expansion coefficients, whilst the thermal conductivity is obtained from analysis of the rate of heat flow during the period whilst thermal equilibrium is being established. J. H. A.

520. Generalised Thermodynamic Properties of Higher Hydrocarbon Vapours. J. Q. Cope, W. K. Lewis and H. C. Weber. *Indust. and Engin. Chem.* 23. *pp.* 887–892, *Aug.*, 1931.—When plotted against the ratio of reduced pressure to reduced temperature, all the available results of direct experimental determinations of deviations from the gas laws for the saturated vapours of hydrocarbons having more than two C atoms per molecule fall on a single curve with a maximum divergence of about 3 %. Analysis of the data indicates that, up to moderate pressures, the deviations from the gas laws of hydrocarbons with over three C atoms per molecule are approximately the same for equal values of reduced temperature and pressure, whether the vapours are saturated or not. These relations are valid up to the value about 4 for RT/P_cV, but not beyond. It thus becomes possible to estimate the vapour volume and vapour density of a hydrocarbon under any given conditions of temperature and pressure from a knowledge of molecular weight and critical pressure and temperature alone. The graphic relationships may be expressed by approximate algebraic forms corrected by graphic functions obtained from the original data, from which, by graphic integration, the internal energy and total heat of hydrocarbon vapours as functions of temperature and pressure are obtained. With these it is possible to compute the heat consumption and energy changes of various processes. Assuming additivity of volumes and total heats on admixture of vapours at constant pressure, it is possible to estimate the volumetric and thermal relationships of vapour mixtures. Hence a graphic method is available for determining the volume and the thermal properties of the vapour of any higher hydrocarbon up to and somewhat beyond its critical conditions. T. H. P.

521. Variation of the Quantities "a" and "b" in van der Waals' Equation. Part III. Critical Data. J. J. van Laar. *K. Akad. Amsterdam, Proc.* 34. 7. *pp.* 977–987, 1931. *In German.*—In continuation of a discussion on the quantities a and b in the equation of state for hydrogen [see Abstract 2742 (1931)], the critical data are now considered. A value for the ratio $r = (v/b)_k$ (at the critical point) cannot be calculated from known critical data, and has to be assumed to be 2·5. It is shown, however, that the three critical quantities v_k, T_k and p_k are completely determined from a knowledge of the five quantities, a_k, y, b_k, b_k', and b_k'', of which $b_k' = \left(\frac{db}{dv}\right)_t$ and $b_k'' = \left(\frac{d^2b}{dv^2}\right)_t$, and y depends on the variation of a with v. At ordinary temperatures both b and a are known functions of v; but if these functions are assumed to hold down to low temperatures, calculations of critical data do not agree with experimental values. It follows that the variations of a and b, with temperature and volume, have yet to be found for low temperatures. The calculated value of b, when $p = \infty$, is in fair agreement with the value derived from Bridgman's high pressure experiments. Finally, the influence of the Boltzmann effect on the suggested variations is discussed. J. P. A.

522. Empirical Evaluation of Potential of van der Waals' Forces Near a Molecule. K. Wohl. *Zeits. f. phys. Chem.* 14. *Abt.B.* 1. *pp.* 36–65, *Sept.*, 1931.—Considers a potential due to attracting and repelling forces, both being proportional to inverse powers of the distance. The index of the repelling force increases with complexity of the molecule, and the calculated molecular distances for equilibrium under such forces agree with the volume of the fluid at absolute zero. J. H. A.

SOUND.

523. Velocity of Sound in Hydrogen Gas at Liquid Hydrogen Temperatures. A. van Itterbeek and W. H. Keesom. *K. Akad. Amsterdam, Proc.* 34. 7. *pp.* 988–995, 1931, *Comm. No.* 216*c from the Phys. Lab. Leiden.*—The velocity of sound in hydrogen gas is determined by a method previously described [see Abstract 2748 (1931)] at temperatures between 17·17° K. and 20·42° K., and at pressures from 0·1 to 1·0 atmosphere. If W is the velocity of sound, p the pressure, $W^2 = N(1 + Pp + Qp^2)$. Values at different temperatures of the constants N, P, Q, are tabulated, and the ratio $(c_p/c_v)_{p=0}$, calculated from N, is sensibly constant over the whole temperature range. [See also following Abstract.] J. P. A.

524. Velocity of Sound in Oxygen Gas. W. H. Keesom, A. van Itterbeek and J. A. van Lammeren. *K. Akad. Amsterdam, Proc.* 34. 7. *pp.* 996–1003, 1931. *Comm. No.* 216*d from the Phys. Lab., Leiden.*—By a method previously described [see Abstract 2748 (1931)] the velocity of sound in oxygen gas is determined at 0° C. and at temperatures between 164·63° K. to 77·48° K., and at pressures between 0·1 and 1·0 atmosphere. From the results c_p and c_v and their ratio c_p/c_v are determined. By extrapolation, the value of this ratio at zero pressure is obtained at various temperatures, and is found to be always slightly greater than 1·400. Whether or not this small deviation indicates a departure from classical dynamics cannot, however, be decided at present. If W is the velocity of sound, p the pressure, N, P, Q functions of temperature only, then $W^2 = N(1 + Pp + Qp^2)$. Values of N, P and Q are tabulated. The variation of W with pressure is not so great as in the case of hydrogen [see preceding Abstract]. From N is deduced a formula for the temperature variation of the second virial coefficient. J. P. A.

525. Simplified Instrumental Method of Measuring Sound Absorption Coefficients. J. F. Mackell. *Science*, 74. *pp.* 224–225, *Aug.* 28, 1931.—Sound is produced by blowing a metal organ pipe with compressed air at constant pressure. The sound is received in a microphone of the condenser or double-button type the output of which is passed into a 4-stage transformer-coupled a.c. amplifier. The output of the amplifier is fed through a volume control potentiometer into a step-down current transformer from which it passes to a thermocouple galvanometer which reads directly in arbitrary energy units. The time of cutting off the air from the organ pipe and switching in the galvanometer is regulated by means of a metronome, and the galvanometer readings for different time intervals give a curve of sound decay from which the absorption coefficient may be found. G. E. A.

526. Supersonic Satellites and Velocity. W. H. Pielemeier. *Phys. Rev.* 38. *pp.* 1236–1246, *Sept.* 15, 1931.—With increasing path length in a Pierce acoustic interferometer, minor peaks, or "satellites," were found to develop in the curves which correlate $(I_p - I_b)$, the excess of plate current over bias current, and x, the mirror position. Several such curves are given. Evidence that these satellites are caused by multiple reflection is presented. The acoustic velocity as determined by these

satellites differs by less than 0·06 % from the theoretical value, $V = (\gamma p/d)^{1/2}$, whereas the major peaks yield a velocity which, in every case, exceeds the theoretical value by more than 0·5 %. Apparently the velocity approaches a limiting minimum value with decreasing intensity, but is independent of frequency. [See also Abstract 910 (1931).]
AUTHOR.

527. Experimental Investigation of Edge Tones. H. Klug. *Ann. d. Physik,* 11. 1. *pp.* 53–72, *Sept.* 2, 1931.—Attempts made to find, by spark kinematography, the edge vortices required by Krüger's theory were unsuccessful [see Abstract 1121 (1921)]. Further experiments were made in which a disturbing wedge was brought in from the side towards the moving air lamella, and positions found between the slit and the edge at which disturbance of the tone begins. These positions lie on a curve which approximates to a sine curve. The effect was also looked for, using an apparatus in water, but the experiments yielded nothing further to the knowledge of the mechanism of formation of edge tones. It is concluded that Krüger's simple vortex theory of edge tone formation will require to be extended before the observed effects can be fully explained. [See also Abstract 1078 (1926).] G. E. A.

528. Phonoscopic Devices. G. Panconcelli-Calzia. *Ann. d. Physik,* 10. 6. *pp.* 673–680, *Aug.* 11, 1931.—References from literature are quoted to show that the word phonoscope has been used since 1862, and that the phonoscope, as now understood, was first devised in 1885 by Forchhammer, a teacher of deaf mutes in Copenhagen, who employed in his methods both the disc and the drum. G. E. A.

529. Measurement of Amplitude of Oscillation of Solid Bodies. G. v. Békésy. *Ann. d. Physik,* 11. 2. *pp.* 227–232, *Sept.* 11, 1931.—A modification of the method of Backhaus [see Abstract 3502 (1930)] for measuring the amplitude of vibration of solid bodies, *e.g.*, the sound board of a piano. In this case a second oscillating body is placed in contact with the body under examination, and if the phase and amplitude of both bodies at the point of contact are the same, no distortion is produced in the oscillation. The maximum amplitudes of the test body can be measured by a microscope and other amplitudes can be obtained by increasing the damping. So, using an electric circuit with 4-valve amplification, the oscillation amplitude of a 'cello is found to be 10^{-4} mm. to an accuracy of 1–2 %. H. M. B.

530. Reverberation Bridge. H. E. Hollmann and T. Schultes. *E.N.T.* 8. *pp.* 387–392, *Sept.,* 1931.—The measurement of the period of reverberation of an auditorium by means of a stop-watch has obvious disadvantages, and calculation from an oscillograph is unsatisfactory on account of irregularities in the decay usually experienced. The authors describe a modification of the Olson-Kreuzer reverberation bridge (*Acoustical Soc. of America. J.* 1. *p.* 78, 1930). In principle, a balance is obtained between the decay of the sound picked up by a microphone when rectified by a diode and the decay of potential of a discharging resistance-capacity combination of known adjustable time-constant. A compensating circuit consisting of two oppositely connected diodes, with change-over resistance-capacity networks, is added to obtain an improved galvanometer balance in spite of irregularities in the decaying reverberant sound. L. E. C. H.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

531. Transmission of Electrons through an Electrical Condenser. W. Wetzel. *Phys. Rev.* 38. *pp.* 1205–1208, *Sept.* 15, 1931.—The formula for the transmission coefficient of electrons is calculated for a potential barrier characteristic of an ideal electrical condenser. Curves are drawn showing, for particular cases, the variation of the coefficient as a function of the condenser thickness and as a function of the final kinetic energy. AUTHOR.

532. Measurement of Dielectric Constants. E. Cohn. *Phys. Zeits.* 32. *pp.* 687–688, *Sept.* 1, 1931.—Criticises the " ellipsoid method " devised by Fürth for the measurement of dielectric constants of conductors. The method is not suitable for exact absolute measurements, but it may be used for comparative measurements of electrolytes. E.E.F.D'A.

533. Dielectric Constants of Certain Organic Liquids at Medium Frequency. W. R. Pyle. *Phys. Rev.* 38. *pp.* 1057–1070, *Sept.* 1, 1931.—At a frequency of 85·8 kc. the dielectric constant was determined at one temperature for each of the following: benzene, 2·279 at 22·9° C.; cinnamic aldehyde, 16·918 at 24·2° C.; ethyl ether, 4·197 at 26·9° C.; methyl cyclohexane, 2·071 at 24·8° C.; methyl *o*-nitrobenzoate, 27·756 at 26·9° C.; nitrobenzene, 34·369 at 26·1° C.; oxalyl chloride, 3·470 at 21·2° C.; *n*-propyl ether, 3·394 at 25·7° C.; *iso*-propyl ether, 4·449 at 25·9° C.; and propylene chloride, 8·925 at 26·1° C. At this same frequency the temperature coefficients of the dielectric constants for ortho-, meta-, and para-xylenes were determined over a temperature range of about 30° C. The data on the three xylenes were tested with the Debye theory. AUTHOR.

534. Dielectric Constants of Liquids under High Pressure. W. E. Danforth, Jr. *Phys. Rev.* 38. *pp.* 1224–1235, *Sept.* 15, 1931.—Values of the dielectric constant have been determined for ten liquids at two temperatures and at pressures up to 12,000 atmospheres except in those cases where freezing would occur at lower pressures. For chloro- and bromobenzene, eugenol, hexyl, isobutyl, and ethyl alcohol, and glycerin, the reciprocal of the Clausius-Mossotti function varies linearly with the density. Carbon disulphide, pentane and ethyl ether, behave in a somewhat more complicated manner. The linear relations can be explained by variations of the constant of the inner field, the polarisability, or both. A theoretical discussion is given. Anomalous dispersion at 247,000 $\sim$ was observed for eugenol, isobutyl alcohol and glycerin. AUTHOR.

535. Dielectric Constants and Dipole Moments of Prussic Acid and Cyanogen. H. Braune and T. Asche. *Zeits. f. phys. Chem.* 14. *Abt.B.* 1. *pp.* 18–26, *Sept.*, 1931.—In the course of an investigation of the Sutherland constants of a series of gases [see Abstract 3614 (1930)] the temperature dependences of the dielectric constants of prussic acid and cyanogen were measured in the gaseous state; experimental details are included. The dipole moments were then calculated to be $2\cdot88 \times 10^{-18}$ for the former and $0\cdot3 \times 10^{-18}$ for the latter. H. H. Ho.

536. Dipole Moment of Prussic (Hydrocyanic) Acid. H. Lütgert. *Zeits. f. phys. Chem.* 14. *Abt. B.* 1. *pp.* 27–30, *Sept.*, 1931.—A dipole moment of $2\cdot53 \times 10^{-18}$ has been calculated for prussic acid in different concentrations in benzene solutions at different temperatures, and of $2\cdot60 \times 10^{-18}$ in *p*-xylol at 20°, from measurements of the dielectric constant by the electrical resonance method, details of which are given.

H. H. Ho.

537. Electric Moments of Symmetrical Hexasubstituted Benzenes. H. Lütgert. *Zeits. f. phys. Chem.* 14. *Abt. B.* 1. *pp.* 31–35, *Sept.*, 1931.—This is an investigation into the spatial requirements of substituents, for which purpose the electric moments of the following symmetrical hexasubstituted benzenes with two different substituents were determined at 0°, *viz.*, tribromomesitylene [total polarisation, 66 ± 1; electronic polarisation (calculated), 63; atom polarisation, 3 ± 1] in carbon tetrachloride solution, trinitromesitylene (74·5 ± 1; 54; 20 ± 1) in benzene, and tribromotrinitrobenzene (91 ± 2; 63; 28 ± 2) in benzene. Preparative details are included and conclusions drawn as to the spatial arrangement of the substituents. H. H. Ho.

538. Dipole Measurements of Benzene Derivatives. Part II. Amino-Compounds. L. Tiganik. *Zeits. f. phys. Chem.* 14. *Abt. B.* 2. *pp.* 135–148, *Sept.*, 1931.—In continuation of this work [see Abstract 4271 (1931)]the dipole moments of 16 aromatic amines have been evaluated, and, from the data obtained, it appears that the direction sense of the NH_2-group moment is in all cases like that of the methyl group. An expression is derived for the total moment of a dipole molecule with two free rotations, and the inclination of the dipole moment of the NH_2-group with respect to the valency bond is estimated at about 40°. H. H. Ho.

539. Dipole Moments of Inorganic Compounds. H. Ulich and W. Nespital. *Zeits. f. Elektrochem.* 37. *pp.* 559–562; *Disc.*, 562–563, *Aug.–Sept.*, 1931.—According to the Hund theory, most halides possess a symmetrical structure and should therefore have a zero dipole moment. This expectation has been realised in the free monomolecular state of carbon tetrachloride, stannic iodide, boron trichloride and stannic chloride; probably also in the cases of aluminium bromide, beryllium chloride and bromide, silicon and germanium chlorides and finally for the double molecular aluminium bromide. Deviations occur with arsenic and antimony trichlorides. H. H. Ho.

540. Electric Discharges in Rock-Salt. Lydia Inge and A. Walther. *Zeits. f. Physik*, 71. 9–10. *pp.* 627–645, *Sept.* 19, 1931.—An investigation was made of the directions in which electric discharges in rock-salt spread, under different polarities and temperatures. It was found that the positive discharge, for temperatures between 0° and 150° C., follows principally the direction of the diagonal of the cube [1, 1, 1], and from 150° to 450° C. mainly the surface diagonal [1, 1, 0]. For negative discharges between 0° and 150° C. the direction of spreading is indeterminate. From 150° to 450° C. the discharge generally follows the direction of the edge [1, 0, 0]. After heating to 450° C. the negative discharge at room temperature also follows the direction of the edge. In the case of the positive discharge the rate of spreading when the rock-salt is subjected to X-rays is greater than without them. No difference is found in the case of the negative discharge. The field strength required to produce the discharge is very close to 2 × 10^6 volts/cm. and appears to be independent of both temperature and polarity. The rate of spreading of the discharge is greater for the positive than for the negative and increases from room-temperature up to 150° C., beyond which it alters very little. The results show that it is probable, in the case of the positive discharge, that ionisation by electrons is important, while in the negative discharge positive ions play a large part. [See also Abstract 577 (1931).] A. W.

541. Atmospheric Electricity. Electric Field at the Top of the Puy de Dôme. E. Mathias and G. Grenet. *Comptes Rendus,* 193. *pp.* 470–473, *Sept.* 28, 1931.—The Benndorf self-registering electrometers, used to measure electric fields in the atmosphere, are lodged in huts, the walls of which are about 1 m. from the fields which are being registered. The altitude of the plateau is 1440 m. In winter there is a simple diurnal oscillation with a minimum of 120 *v/m* at about 2 hrs. and a maximum of 240 *v/m* at 15 hrs. In spring and autumn the fluctuations are irregular—and they are even more marked in summer. The mean gradient is a maximum in winter and a minimum in summer. This agrees with other stations, although over the ocean the amplitude is very much smaller.
H. M. B.

542. Rate of Charging of a Stratus Cloud. H. G. Müller. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 2.) 33. *pp.* 125–129, 1931.—The Arendt-Kallmann theory regarding charged suspended particles applies for atmospheric layers near the ground with a strong space charge of one sign, and for old clouds, but not for clouds at a high level. A rough calculation is made for a stratus cloud at a height of 1000 m. and 100 m. thick on the lines of Elster and Geitel and of Linke. This shows the rate of decrease of the electric field, cloud to earth, and indicates that the charge quickly follows the normal changes of weather conditions, but not sudden changes. Numerical results are difficult to obtain, but those of Linke, Wigand and Idrac support this view. Also Idrac's measurements on the rate of charge in relatively undisturbed layers show that frequently such a double layer forms with a regular vertical distribution of charge. This opposes Elster and Geitel's view that the charge is confined to a relatively thin surface layer. R. S. R.

543. Atmospheric Ionisation at Glencree, Co. Wicklow. J. J. Nolan and P. J. Nolan. *Roy. Irish Acad., Proc.* 40. *pp.* 11–59, *Sept.,* 1931.—The paper provides an extension of an earlier report [see Abstract 2895 (1930)] to cover the period October 1928–December 1930, giving better average conditions, although observations in the summer months are scanty. Observations were made of (1) concentration of small ions, + and −, (2) concentration of charged and uncharged nuclei, and (3) relevant meteorological information. Eliminating disturbing influences the average concentrations of small ions were $n_+ = 495$ and $n_- = 369$. Rain diminished the value of n_+ and increased that for n_- but had no marked effect on Z. The ratio n_+/n_- decreases with temperature, absolute or relative humidity increases. Regular diurnal variations of n_+, n_- and Z were found while the ratio n_+/n_- showed a diurnal variation similar to that of universal potential gradient. The ion-counting instrument at Glencree was compared with an Ebert instrument and a discrepancy was found, but the cause was unexplained. Both showed that the relative concentration of intermediate ions increased with decreasing concentration of small ions. The formula $q = an^2 + 2\eta_2 n N_\pm$ gives values of q much too low except for high values of $N_\pm$ or Z. The empirical formula $q = an_2 + \zeta n\sqrt{Z}$, while not completely satisfactory, accounts better for the relations between n and Z. A diurnal variation for q similar to that of the universal potential gradient was indicated. R. S. R.

544. Results of the Continuous Record of Atmospherics. J. Asakura. *Radio Research Japan, Reports,* 1. *pp.* 113–126, *Aug.,* 1931.—Almost continuous records extend over three years from an apparatus consisting of detector, relay and recorder. The apparatus is described. The diurnal variation of atmospherics shows maxima at 16 and 21 hours and minima at 7·5 and 19 hours, those in months of high temperature being especially remarkable. The number of atmospherics at night is greater than during the day except in summer, while the minima are liable to be disturbed by thunderstorms. The minima are probably due to the great scattering of the waves caused by irregular reflection and refraction in the Kennelly-Heaviside layer. The annual variation shows a maximum in Tokyo in July and a minimum in February while the results so far indicate that the yearly decrease of atmospherics agrees with the yearly decrease of the Wolfer-Brunner's sunspot number. The number of atmospherics is inversely proportional to barometric pressure, with a few exceptions, and directly proportional to air temperature and thunderstorm frequency. With lines of discontinuity in the vicinity there is a considerable increase of atmospherics, while on showery days with thunderstorms there is a considerable fluctuation. It is considered that regular observation of atmospherics will be of assistance to weather forecasting. R. S. R.

545. Correlation of Atmospherics with Thunderstorms. A. Kimpara. *Radio Research Japan, Reports,* 1. *pp.* 127–150, *Aug.,* 1931.—Observations were made at weekly or fortnightly intervals for a year at six stations to obtain the direction of arrival of atmospherics and the results are shown in a polar diagram. The indications are best for thunderstorms at medium distances, but mountainous districts cause a scattering. The diagrams show that in the direction of (1) observed thunderstorms, mostly a clear maximum and a secondary broad maximum are found, (2) typhoons, clear and broad maxima are equal, and (3) lines of discontinuity, mostly broad maxima are found. Seasonal changes show that atmospherics originating from (1) definite directions, are closely related to local thunderstorms of the corresponding district, (2) thunderstorms in the South Sea region, especially those from the warm current at night, always mark those of local origin, and (3) regions other than the South Sea are not very strong and are observable only when those of local origin are not active. R. S. R.

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546. Height of Polar Aurora in Canada. J. C. McLennan, H. S. Wynne-Edwards and H. J. C. Ireton. *Canad. J. of Research,* 5. *pp.* 285–296, *Sept.,* 1931.—Simultaneous photographs of the polar aurora were made at two stations in northern Ontario, Canada, and from them a number of values for the height and position were obtained. For the lower limits of arcs and bands these ranged between 70 and 130 km. with a maximum frequency between 90 and 95 km. The mean height for all such lower limits was 95 km. The distribution of the points with reference to the earth's surface is shown. AUTHORS.

547. Light of the Night Sky. J. Kaplan. *Phys. Rev.* 38. *pp.* 1048–1051, *Sept.* 1, 1931.—The two lines at 4416 Å. and 4168 Å., recently reported by (Lord) Rayleigh [see Abstract 2989 (1931)] in the light of a very bright night sky, are identified as OII lines. A theory is proposed which accounts for the strong excitation of the green aurora line both in the night sky and in the aurora borealis. The theory explains why no O_2+ bands are found in the aurora while N_2+ bands are very strong. Explanations are proposed for the two lines of singly-ionised oxygen and for the continuous spectrum in the night sky. Experiments performed by the writer substantiate the theory. AUTHOR.

548. Observations of the Aurora Australis, Byrd Antarctic Expedition, 1929. F. T. Davies. *Terr. Mag.* 36. *pp.* 199–230, *Sept.*, 1931.—Observations were made from March to September, 1929, and spread over a 24-hour watch. The form (glow, arch, curtain, ray and streamer and corona) was observed, and the intensity, direction, altitude and colour were estimated. During the period of observation, (*a*) the average intensity decreased continuously from April to September; (*b*) the frequency of displays seen, to those possible, decreased; (*c*) although most displays were seen in the east, the proportion in the west increased; (*d*) the proportion of displays at a high altitude and the mean altitude increased; and (*e*) the proportion of displays with ray structure increased. The increase of auroral activity on the same day or the day after the maximum of magnetic character was noted. A period corresponding to that of solar rotation, 26–30 days, was observed. Particulars are given of the diurnal variation in intensity and the diurnal and monthly variation in type. No audible phenomena could be associated with the aurora, and no aurora were seen below cloud level. R. S. R.

549. Magnetic Disturbances Observed in Potsdam on South Norwegian Auroral Days. A. Rostad. *Geofysiske Publ.* 9. 3. [31 *pp.*], 1931.—Statistical relations between the magnetic disturbance intensity and the distance of the auroral phenomenon from the earth's magnetic pole as observed in Oslo show a straight line for Potsdam but a curve for Tucson, Arizona, the latter agreeing with theory. The temporary variations of the disturbing force have a daily period whose maximum is displaced from 20 G.M.T. to the early afternoon for very great disturbances. While the slight auroral disturbances at Oslo produce simultaneous changes in Potsdam and Tucson, with increased intensity the difference in times of maxima is approximately equal to that of local time at the two places. The component of the magnetic disturbance parallel to the earth's magnetic axis expressed as a percentage of the total force shows a diurnal period and a non-periodic variation. The ratios of the circular component and of the radial component to the total disturbing force vary with the intensity and the time of day. In the evening the disturbing force is mainly axial, but in the morning mainly horizontal and directed to the south. The quarter-hourly oscillation and the disturbing intensity show a curved relation with increasing intensity, but probably a straight line with very great intensities. The curve depends on the daily time, and is of cardioid form, but its physical significance is doubtful. R. S. R.

550. Solar Component of Cosmic Radiation. A. Corlin and V. F. Hess. *Gerlands Beitr. z. Geophys.* 31. 1–3. *pp.* 169–172, 1931.—The authors have examined the records of the observations on cosmic radiation made by Hoffmann and Lindholm at Muottas Muraigl (height 2450 m.) in the upper Engadine and from these they conclude that there is a solar component, though a very small one, of cosmic radiation. They deduce the enfeeblement coefficient μ of the solar component to have, when stated for unit density, the value $(\mu/\rho) = 5 \cdot 7 \times 10^{-3}$ cm.^{2}/gm., which agrees with the value got from the total radiation by screening with a sheet of lead 10 cm. thick. The observations recorded by Lindholm in June–July, 1928, have been analysed for possible sources of error, and the records with and without screening, by day and by night, examined, and the comparison is given. From these results the enfeeblement coefficient of the solar cosmic radiation when screened by 10 cm. lead is calculated to be $\mu_{Pb} = 0 \cdot 147$ cm.$^{-1}$ and the mean error is calculated to be $0 \cdot 09$ cm.$^{-1}$. This value for μ_{Pb} of the solar component is about twice as great as the value previously given from another series of records. But considering the high value of the possible error the result of the comparison is considered as satisfactory. Comparing the enfeeblement coefficient of the γ-radiation of RaC in lead ($0 \cdot 51$ cm.$^{-1}$) with the calculated value (giving only an upper limit), the solar effect of cosmic radiation has much greater penetrating capacity than the γ-radiation mentioned. The observations of Lindholm in Jan. and Feb. of 1929 are also discussed. From all the observations from Jan., 1928, to Mar., 1929, the value of μ_{Pb} is estimated to be $0 \cdot 065$ cm.$^{-1}$. Hence the mass absorption coefficient $\mu/\rho = 5 \cdot 75 \times 10^{-3}$ cm.^{2}/gm. A further analysis of recent results is about to be published. J. J. S.

551. Counting Tube Effect and Laws of Absorption of Cosmic Radiation. L. Tuwim. *Preuss. Akad. Wiss. Berlin, Ber.* 19. *pp.* 360–373, 1931.—Reference is made to an expression developed by the author for free radiation from the whole sky when having a constant inclination of the counting tube to the vertical but varying depths and absorption coefficients, and from this the laws of absorption for cosmic radiation are obtained. These give small differences from those obtained with an ionisation chamber. Expressions are also developed for the latter. If one obtains with free radiation at all azimuths for all measuring regions, the absorption of cosmic radiation with (1) an ionisation chamber, and (2) a tube with radius/length $\not> 1:50$ two different absorption curves are obtained. By choice of the unit so that for a mean depth the curves agree, then at no point do they differ by more than ± 4 % for the greatest heights and depths. Generally it is found that for any angle between the counting tube and the vertical the count is represented with sufficient accuracy by a linear equation for both main and normal places, and the coefficients of this linear function depend only on the angle and not on the depth or absorption coefficient. R. S. R.

552. Nature of Ultra-Radiation. J. Barnóthy and Magdalena Forró. *Zeits. f. Physik,* 71. 11–12. *pp.* 778–791, *Sept.* 26, 1931.—Two Geiger counter tubes were mounted parallel to one another, with their axes in the direction of the magnetic meridian. The distance between them was kept constant and while one of them, A, was kept fixed, the other, B, was moved so that its axis moved in a cylinder, the axis of which coincided with the axis of A. Its rotation about A was measured on a graduated circle, the zero of which corresponded to the horizontal direction to the west of A. The tubes were shielded from the radioactive effects from the ground by a thick layer of lead. Measurements of the number of coincident impulses in the two tubes in a given time were made, in positions varying from 50° (west side of the vertical plane) to 140° (to the east). Maxima of intensity were found at 90° (vertical) and 120°. Further experiments on these lines are proposed. H. N. A.

553. Observations of Magnetic Anomalies with a Variometer. J. G. Koenigsberger. *Terr. Mag.* 36. *pp.* 243–249, *Sept.*, 1931.—The accuracy of determinations for magnetic anomalies in horizontal intensity, H, and vertical intensity, Z, using the author's variometer, is now as good as that obtained by absolute measurements. The variometer can be used accurately without resetting for determinations on lines as long as 300 km. in the north-south direction. The question as to whether local anomalies may be affected by secular variations is discussed theoretically. An attempt to check the theory developed using previous observations of intensity gives no definite conclusions; absolute measurements of inclination with the dip-needle are not of sufficient accuracy to give a reliable test. In the study of a deep-seated regional anomaly and in the preparation of land magnetic charts, it is found best to discard all values at stations where the adjacent rocks have differences of susceptibility of more than 2×10^{-4}. AUTHOR.

CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

554. Conductivities of Hydrocarbons and Transformer Oil. L. A. Welo. *Physics*, 1. *pp.* 160–170, *Sept.*, 1931.—A method is described for removing moisture, air and soluble and suspended matter from oils and hydrocarbons in preparation for measurements of the d.c. conductivities and the power factors. The method at the same time provides for cleaning of the measuring cell and insures that no contamination occurs while measurements are being made. Normal decane, transformer oil and dimethyl octane were studied. In each case, d.c. conductivities in the lower range of 10^{-18} ohm^{-1} cm.$^{-1}$ were obtained, suggesting that if individual hydrocarbons have characteristic d.c. conductivities they must be of the order 10^{-19} or lower. In each substance the power factor was reduced to $\cos \theta = 0 \cdot 0004$ at room-temperatures. A normal temperature-power factor function was found for the purified transformer oil. Near saturation was observed at the early stages of purification. Then, as purification proceeded, there was approach to Ohm's law, and finally approach to saturation again. It is pointed out that saturation at the early stages is the unexpected and unexplained feature. Some time-current curves and volt-ampere characteristics bearing on the phenomenon of electrical cleaning are included. AUTHOR.

555. Conductivity of Silver Sulphide. C. Tubandt and H. Reinhold. *Zeits. f. Elektrochem.* 37. *pp.* 589–593; *Disc.*, 593, *Aug.-Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May*, 1931.—The regular α-Ag_2S existing above 179° C. shows itself to be a pure kation conductor obeying Faraday's law. On transformation into the rhombic β-modification there takes place simultaneously with decrease of the conductivity a sudden change of the kind of conductivity. The β-Ag_2S is a mixed conductor, with a portion having electronic conduction which with decreasing temperature progressively gets less till at about 0° C., as with α-Ag_2S, again only pure ionic conduction occurs. The authors describe the various results obtained by different investigators, and find that it may be considered established that in α-Ag_2S two kinds of conducting ions exist: a large number of ions (lattice ions) with small mobility which find their expression in the diffusion velocity, and a probably very small number of Ag+ ions of abnormally high mobility, which impart to the pure α-Ag_2S its extraordinary mobility without markedly influencing the velocity of diffusion, but on the contrary in the Ag_2S charged with sulphur lose their high mobility and approximate to lattice ions. J. J. S.

556. Electrical Resistance of Carbon. Z. Nishiyama. *Zeits. f. Physik*, 71. 9–10. *pp*. 600–615, *Sept*. 19, 1931.—An explanation is sought for the anomalous electrical conductivity of carbon. The electrical resistance of carbon filaments was measured for temperatures between 0° and 2000° C., and the size of the constituent carbon particles was measured with the aid of X-rays. The filaments were prepared by depositing the carbon, obtained from the decomposition of CCl_4 *in vacuo*, on a charred thread, and were afterwards subjected to various forms of heat treatment. The conclusion is reached that carbon originally behaves electrically as a metal, but that the exceeding fineness of the particles effects an apparently anomalous change in its electrical resistance. A tentative theory of this phenomenon is given. J. E. K.

557. Electrical Conductivity and Structure of Thin Sheets of Metal. Part IV. Practical Applications. L. Hamburger. *Ann. d. Physik*, 11. 1. *pp*. 40–52, *Sept*. 2, 1931.—Shows that there is a connection between the results previously obtained by the author [see Abstract 191 (1932)] with thin metallic layers, and the high specific resistances and abnormal temperature coefficients sometimes observed when the crystallites of a metal are very small. The special condition in which the ultramicroscopic particles of a metal exist in thin layers and their peculiar properties go to explain the fact that certain metals act as catalysts in a very minute state of subdivision, but lose this property when the grains amalgamate to form larger particles. Another example of change in the properties of a metal in a very finely divided state is found in certain incandescent lamps, the bulbs of which are coated on the inside with an extremely thin layer of calcium fluoride. This is found to delay the blackening of the bulb by the tungsten vapour evaporated from the filament. This seems to be due to the fact that the surface of the calcium fluoride is not smooth like that of glass, and so the tungsten is spread over a very large surface, and its properties are altered so that it does not absorb as much light.

H. N. A.

558. Behaviour of Powdered Metals under Pressure. F. Skaupy and O. Kantorowicz. *Zeits. f. Elektrochem.* 37. *pp*. 482–488; *Disc.*, 491–492, *Aug.–Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May*, 1931.—Metallic powders when exposed to external pressure exhibit a certain clinging together which shows that forces of cohesion exist, and indeed surface forces of the nature of adhesion. These are greater when the surfaces of contact are more extensive. Similarly, the electric resistance is less when the powdered metals are more compactly held together. The authors have examined the behaviour of metals when powdered and give in this paper a short description of their methods and results. The resistance of a metallic powder varies with its compactness, and a table giving experimental results shows that iron, nickel and tungsten when powdered may have a resistance more than a hundred times that of the compact metal. The resistance of a metallic powder under pressure may be represented within wide limits by an equation of the form

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$1/R = c\sqrt{P} + C$, where c and C are constants depending on the material and its previous treatment. This corresponds with R. Holm's results for the contact resistance of touching spheres. The resistance-pressure curve is irreversible. The longer a powder remains under constant pressure the smaller becomes the resistance. The resistance of a metal powder depends on the size of the particles or the distribution of the size. J. J. S.

559. H.F. Resistance of Lead at Superconducting Temperatures. J. C. McLennan, A. C. Burton, A. Pitt and J. O. Wilhelm. *Phil. Mag.* 12. *pp.* 707–719, *Sept.*, 1931.—It has been suggested that some kind of orientation must be involved in the superconducting state, and that this will probably disappear as high frequencies are used. The frequency must have a time period of the order of or less than the " time of relaxation " of the solid. To test the points the behaviour of an oscillatory circuit composed entirely of lead was examined at low temperatures. Using a frequency of 11×10^6 cycles per sec., no discontinuity was observed in passing through the superconducting point to 4·2° K. It is inferred that there must be an orientation phenomenon with a time period large compared with 10^{-7} sec. G. E. B.

560. Luminosity of Carborundum Detectors. O. W. Lossew. *Phys. Zeits.* 32. *pp.* 692–696, *Sept.* 1, 1931.—Carborundum detectors show a luminous layer about 0·02 mm. thick under a p.d. of about 10 volts. The colour changes rapidly with the voltage, extending its limit towards the shorter waves. The luminous layer was examined microscopically from the temperature of liquid air to a gentle red heat. The author discusses the connection between the optical properties of the crystal, such as pleochroism and limitation of the absorption band with its unipolar conductivity. E. E. F. d'A.

561. Rectifying Effect and Luminous Phenomena with Carborundum Crystals. B. Claus. *Ann. d. Physik*, 11. 3. *pp.* 331–356, *Sept.* 20, 1931.—The relation between current and pressure on the contact point of a carborundum crystal rectifier included in an electric circuit is investigated, and a critical pressure is found at which a sudden great rise of current takes place. Two kinds of luminous phenomena accompany the current, a yellow surface luminescence when the metal point is the kathode, and a blue luminescence in the form of a large number of bright points around the point of contact, when the metal point is the anode. The spectra contain no lines. They extend, at ordinary temperatures, into the green and ultra-violet respectively, and the position of maximum intensity of the surface luminescence varies considerably with the temperature. Current-potential characteristics show kinks at points where the luminescences appear, but these disappear at liquid air temperature. In the case of point luminescence it is shown that electrons emerge from the points. In general, the surface of a carborundum crystal possesses points of high electrical conductivity. All the results can be accounted for by assuming the luminous effects to be impulse radiation (*Bremsstrahlung*) of electrons. N. D.

562. Preparation of Sensitive Vacuum Thermoelements and Relays by Kathode Sputtering. Z. Klemensiewicz and (Miss) Z. Wasowicz. *Zeits. f. Physik*, 71. 11.–12. *pp.* 817–820, *Sept.* 26, 1931.—Vacuum thermoelements have been constructed by sputtering metallic conductors on thin sheets of insulating material. They are found to be sensitive and of rapid response. The components of the most sensitive element are bismuth and tellurium, but other metals and semi-metals have been examined. J. H. A.

563. H.F. Sparking Potential of Air. E. W. B. Gill and R. H. Donaldson. *Phil. Mag.* 12. *pp.* 719–726, *Sept.*, 1931.—Two arrangements were used, one in which the discharge tube was placed with its axis parallel to the electric field and the other in which the axis of the tube was at right angles to the electric field. The potential necessary to excite discharges in hydrogen at low pressures was measured for wave-lengths from 3 m. to 5620 m. Below 60 m. there is one pressure for which the sparking potential is a minimum, but at higher wave-lengths there are two, one constant and one depending on the wave-length. If the electric field is parallel to the axis of the discharge tube, there is only one minimum. G. E. B.

564. Townsend's Theory, Gas Discharge and Breakdown. W. Rogowski. *Arch. f. Elektrot.* 25. *pp.* 551–596, *Aug.* 14, 1931.—This important paper reviews and discusses the results of many researches on gas discharges and breakdown, with special reference to Townsend's theory. It is considered that if the experimental results are to be trusted, then the positive ions do not play the part assigned to them by Townsend's theory. A brief abstract cannot be given. [See also Abstract 1585 B (1931) and others.] A. W.

565. Electric Breakdown in High Vacuum. H. Schäffer. *Arch. f. Elektrot.* 25. *pp.* 647–648, *Sept.* 10, 1931.—An investigation was made of the electric breakdown in high vacua, using static potentials. For electrodes a pair of deflection plates in an oscillograph were used, the distance apart being about 1·5 cm. The gas pressure was about 10^{-3} mm. of mercury. A second oscillograph was used as measuring instrument. Oscillograms are given showing the effects obtained (*a*) at atmospheric pressure, and (*b*) at low pressure. A remarkable feature is the steepness of the curve for the low pressure, the steepness being about half that for atmospheric pressure. Oscillatory conditions for the two cases are also illustrated and compared. A. W.

566. Spark-Gap Discharge with "Choked" Spark Current. H. Schäffer. *Arch. f. Elektrot.* 25. *pp.* 641–644, *Sept.* 10, 1931.—It is known that the spark discharge with "choked" spark current either develops fully or, if the supply of electricity is sufficient, passes over to the glow type of discharge. The investigation here described is concerned primarily with the latter type of discharge, the object being to observe and measure the residual potential after the start of the discharge, and to find whether there was any dependence on the pressure of the gas at the spark-gap. The experiments were conducted with surge waves along parallel conductors, a kathode-ray oscillograph being employed to obtain photographs from which the potentials could be measured. The results show that the residual potential under the above conditions is slightly greater than the minimum potential. It depends only slightly on the pressure and the "choke" resistance, slightly higher values being found with greater pressures and choke resistances. [See also Abstract 1637 (1931).] A. W.

567. Arc Potentials at the Beginning of an Arc Discharge. H. Schäffer. *Arch. f. Elektrot.* 25. *pp.* 645–646, *Sept.* 10, 1931.—Oscillograph measurements were made of the voltages during the beginning of an arc discharge, and the results obtained were compared with the theoretical values calculated from the Ayrton formula, using Seeliger's figures for the appropriate constants for copper. It was found that the voltage increased with time, as the formula indicates, and the numerical agreement from 5×10^{-5} to 30×10^{-5} sec. was very close. A. W.

568. Unipolar Corona Discharge with Alternating Potential. S. P. Zebrowski. *Arch. f. Elektrot.* 25. *pp.* 649–654 *Sept.* 10, 1931.—An optical method is described by means of which it was established that for thin wires with diameters of the order of 0·2 mm. the corona discharge has a decidedly unipolar character. The intensity of the negative corona is much greater than that of the positive corona for equal potentials. The optical method employed renders it possible to determine the duration of the negative corona in the half period of the applied potential. With a potential of 30 kV the duration was found to be 0·367 of the period of the alternations. [See also Abstract 254 B (1928).] A. W.

569. Electrodeless Discharge: Measurement of Induced Current and Variation of Current with Pressure for Various Gases. C. T. Knipp and J. K. Knipp. *Phys. Rev.* 38. *pp.* 948–954, *Sept.* 1, 1931.—A single re-entrant discharge tube, consisting of two perpendicular circular parts, has been constructed so that the induced gaseous current within can be measured. Pressure-current characteristics are obtained for H, He, N, O, Ne, and A. The maximum induced currents occur at about the following pressures: 0·06 mm. Hg. for O, 0·05 mm. for A and H, 0·2 mm. for Ne, and 0·035 mm. for He and N. Of these gases, H is the most critical in that the electrodeless discharge only occurs between pressures of 0·035 mm. and 0·09 mm. With an exciting current of 57 virtual amperes in each case, the maximum induced current varies from 2·4 amperes in H to 9·9 amperes in O. In every case the induced current is only co-existent with the " bright glow." N. D.

570. Studies with an Ionisation Gauge. N. B. Reynolds. *Physics*, 1. *pp.* 182–191, *Sept.*, 1931.—An ionisation gauge of the type described by Found and Dushman [see Abstract 2317 (1924)] was calibrated for helium, neon, nitrogen, argon and mercury. The results obtained have been compared with those derived by means of a graphical integration based on the probability of ionisation of different gases as a function of electron velocity. The agreement is very satisfactory. The present results indicate that the purely empirical relation between sensitivity and " molecular number " (total number of electrons per molecule), reported in the earlier paper, is not generally valid. AUTHOR.

571. Ultra-Ionisation Potentials in Mercury Vapour. A. G. Shenstone. *Phys. Rev.* 38. *pp.* 873–875, *Sept.* 1, 1931.—It is shown that Takamine's new $^3P_2^0$ level in HgI is probably the lowest level from the structure d^9s^2p. The positions of the other levels are discussed, and it is shown that some of them will be negative. The phenomenon of auto-ionisation is described, and its effect on the negative terms is suggested as the cause for the existence of ultra-ionisation potentials. Some remarks are made regarding perturbed series. AUTHOR.

572. Excitation Probabilities for Electrons in Helium, Neon and Argon. L. C. van Atta. *Phys. Rev.* 38. *pp.* 876–887, *Sept.* 1, 1931.—Electrons scattered inelastically in the forward direction in helium, neon and argon have been studied by means of an electrostatic analyser. Energy distribution curves revealed the 21·11 and 22·96 volt losses in helium, the 16·6 and 18·5 volt losses in neon, and the 11·6 and 13·9 volt losses in argon. Careful measurements of the principal energy losses gave 21·13 ± ·04 volts, 16·64 ± ·05 volts, and 11·53 ± ·05 volts. The relative probability as a function of electron energy was determined for the 21·11, 16·6 and 11·6 volt losses for electron energies between 100 and 300 volts. The 21·11 and 16·6 volt losses increased with electron energy showing maxima at 200 and 160 volts respectively. The 11·6 volt loss decreased sharply between 100 and 150 volts and then remained constant. Special study of ionisation losses in helium showed that an ionising electron may lose as much as half its remaining energy to the ejected electron, but that smaller losses are preferred. AUTHOR.

573. Measurements on the Vapour Stream from the Kathode of a Vacuum Arc. W. E. Berkey and R. C. Mason. *Phys. Rev.* 38. *pp.* 943–947, *Sept.* 1, 1931.—The velocity of the vapour stream issuing from the kathode region of a vacuum arc between copper electrodes is calculated from (1) the energy received by a vane 3 cm. in front of the kathode, as measured by the rate of rise of temperature; (2) the momentum imparted to the vane, as determined by the deflection of the vane. The mass used in the calculations is that of the copper deposited on the vane. The average velocity of the vapour, computed from data obtained by either method, is about 2×10^6 cm. per sec., confirming Tanberg's momentum measurements [see Abstract 3525 (1930)]. There is some evidence that the vapour is ionised to a considerable degree. Radiation from the arc, or energy of recombination on the vane, can account for only a small part of the total energy received by the vane. AUTHORS.

574. Ageing of Ions in Air and Nitrogen. J. Zeleny. *Phys. Rev.* 38 *pp* 969–976, *Sept.* 1, 1931.—Previous work on the mobility of aged ions in air [see Abstract 4095 (1930)] has been extended to the measurement, in air and in nitrogen, of mobilities of ions of different short ages [see Abstract 3924 (1931)]. The ions are produced, by α-rays, directly in the field used for their measurement, and the average age is obtained from the time taken for the ions to cross between the electrodes. Moist, partially dried and dry air as well as nitrogen are used. At the shortest ages, the ions in air all have the same mobility, but with increase of time the mobilities are spread over a range of values, appearing as one or more groups. The positive ions in nitrogen are always contained in one group only, the peak mobility of which ranges from 2·2 at 0·007 sec. to 1·8 at 0·17 sec. H. M. B.

575. Diffraction and Retardation of Electrons. A. Sommerfeld. *Ann. d. Physik*, 11. 3. *pp.* 257–330, *Sept.* 20, 1931.—Part I deals with the diffraction of corpuscular rays by individual atoms or nuclei. It forms a systematic introduction to the treatment of the continuous X-ray spectrum in Part II, and goes beyond the work of Gordon, Mott and Temple only in the matter of method, not in the results. In Part II the author assumes, in contradistinction to Oppenheimer and Sugiura, that the final state of the retarded electron is represented by a plane wave modified by diffraction. Polarisation and intensity in the continuous spectrum are calculated by the method of matrix elements. To obtain the azimuthal distribution of the intensity, in particular the advance of the maximum, the method of calculation has to be refined by taking into account the retardation. The results are compared with the measurements of Kulenkampff. H. L. B.

576. Release of Secondary Electrons from Metals by the Impact of Canal Rays of Hydrogen. G. Schneider. *Ann. d. Physik,* **11.** 3. *pp.* 357–384, *Sept.* 20, 1931.—The number and velocity of secondary electrons which escape almost normally from thin metallic foil of aluminium and gold, owing to the passage of positive rays of hydrogen, are investigated. The results show that a great number of the observed secondary electrons have the velocity which is to be expected from collisions between hydrogen-ions and electrons according to the elementary theory of mechanical collisions. The reasons for the occurrence of slight deviations are discussed. The number of secondary electrons that are released when a hydrogen atom strikes a massive metal plate is also determined. In the region under investigation (23 — 46 kV) this number is found to be independent of the energy of the canal rays and of the material of the plate.

H. L. B.

577. New Form of Geiger Point Counter. M. Steenbeck. *Zeits. f. Physik,* **71.** 7–8. *pp.* 422–430, *Sept.* 3, 1931.—Describes the principle and the connections of a point counter worked with a.c., which registers single quanta, and for the single discharge allows charges to pass which are about 100 times as great as those given by existing forms of point counter. Impulses are only registered when the potential wave has instantaneous positive or negative values greater than a certain amount so that only a certain proportion of the ionising particles or "rays" that enter the counter are registered. It is possible to arrange matters so that each discharge is interrupted while the potential difference passes through the value zero during the alternation. A glow-discharge relay is described which makes it possible to use a counting mechanism, without employing amplifiers. Certain disadvantages of the apparatus are mentioned, in spite of which it may prove useful in technical measurements. H. N. A.

578. Use of the Point Counter in Measurements of External Photoelectric Action. H. Bauer. *Zeits. f. Physik,* **71.** 7–8. *pp.* 532–550, *Sept.* 3, 1931.—The electrons liberated from metals and insulators in a high vacuum by light from different parts of the spectrum were accelerated in an electrical field, and shot into a point counter. By counting the single electrons which entered the counter the last spectral line from a quartz-mercury lamp which produced an effect was determined, and so the position of the long wave-length limit was arrived at for Au, Ag, Cu, Zn, Pb, Cd, Al, and the insulators vulcanite, amber, sulphur and paraffin.

H. N. A.

579. Current in Photoelectric Cells as a Function of the Frequency of Illumination. P. Fourmarier. *Comptes Rendus,* **193.** *pp.* 459–460, *Sept.* 21, 1931.—A periodically varying source of light is obtained by rotating a disc with rectangular holes in front of a lamp. The image of each hole sweeps across three triangular apertures in a screen behind which the photoelectric cell is placed. The resulting current consists of a steady and an alternating part. These components are measured separately, using valve amplifiers. With an Osram cell and working up to frequencies of 11,000 per sec. it is found that the steady component is independent of the frequency. For applied p.d.'s, at which ionisation by collision is important, the alternating component diminishes rapidly with frequency up to 5000 per sec., rises to a maximum between 5000 and 6000 per sec., and then diminishes again. For lower applied p.d.'s the diminution up to 5000 per sec. is much less. For all p.d.'s the curves tend to coincide as high frequencies are approached. A qualitative explanation of these effects is given. N. D.

580. Photoelectric Relay for Magnifying Small Displacements. L. Bergmann. *Phys. Zeits.* 32. *pp.* 688–690, *Sept.* 1, 1931.—The relay is constructed with the new "blocking-layer" selenium cell, which has a large effective surface. Light from a bright source is reflected on to the cell by a galvanometer mirror, disposed in such a manner that the illumination received by the selenium cell varies with the displacement of the mirror. A second galvanometer connected with the selenium shows a deflection 5000 times greater than the original. [See also following Abstract.] E. E. F. d'A.

581. Photoelectric Relay for the Infra-Red. F. Matossi. *Phys. Zeits.* 32. *pp.* 690–691, *Sept.* 1, 1931.—Applies the method described by Bergmann [see preceding Abstract] to the infra-red, using a Moll microthermocouple, a pointolite lamp, and a Siemens galvanometer of sensitiveness $6 \cdot 6 \times 10^{-10}$ ampere. One metre-candle gives with a patch 1 mm. high a maximum deflection of 35,000 mm. Fluorspar rays are easily demonstrated. E. E. F. d'A.

582. Photoelectric Relay for Galvanometer Measurements. A. V. Hill. *Journ. Sci. Instruments*, 8. *pp.* 262–265, *Aug.*, 1931.—The cuprous-oxide-copper photoelectric cell may be used as a relay to magnify galvanometer movements. Two galvanometers are employed. The beam of light from the mirror of the primary falls symmetrically on the two opposed halves of a photoelectric cell. When it moves it produces a current in the secondary. The cell itself has no lag and the current is so large that a relatively insensitive (and therefore rapid) secondary galvanometer can be used, the amplified deflection being almost identical in form with the primary one. With a stable primary galvanometer free from mechanical and other disturbances, the amplification may readily be pushed to the limit beyond which "Brownian" electron movements in the circuit make further magnification useless. AUTHOR.

583. Internal and External Photoelectric Effect. H. Casimir. *Phys. Zeits.* 32. *pp.* 665–667, *Sept.* 1, 1931.—The process called internal conversion, which takes place in radioactive atoms after the emission of an α-particle, is discussed. It is the transformation of the energy of excitation of the nucleus inside the atom. In some atoms a γ-quantum, instead of being emitted, is imparted to an extra-nuclear electron, which is emitted as a β-electron. This is an internal photoelectric effect. In other atoms the γ-quantum emerges. The author has applied relativistic corrections to a formula giving the probability of an internal conversion and has calculated numercially the coefficient of the internal photoelectric effect in certain cases. The values obtained are from one-tenth to one-fifteenth of the experimental values of Ellis and Aston. Hence the author supposes that internal conversion is caused by an unknown interaction near the nucleus. Theoretical values for the ratios of the probability of internal conversion for different states of the same atom and for the same γ-line agree well with experimental values. The photoelectric effect for very hard rays has been measured, and is found to be greater than that which Gray's formula gives. The external photoelectric effect of γ-rays has been calculated in special cases, and shown to be proportional to λ and to the fifth power of the atomic number. N. D.

584. Vectorial Photoelectric Effect in Thin Films of Alkali Metals. H. E. Ives. *Phys. Rev.* 38. *pp.* 1209–1218, *Sept.* 15, 1931.—It is assumed that the photoelectric effect exhibited by thin films of alkali metals on specular platinum surfaces is proportional at any wave-length to the electric intensity just above the platinum. This electric intensity is found, using the optical constants of platinum, by computing the intensities of the wave patterns formed by the interference of the reflected and incident beams. These computations are made for various angles of incidence and for light polarised in and at right angles to the plane of incidence. The intensities thus found exhibit very large ratios of value for the two planes of polarisation, in striking agreement with the characteristics of the vectorial photoelectric effect. The changes of amplitude of the perpendicular electric vector on entering the alkali metal film, as computed from the optical constants of the alkali metal, account for the experimentally found low values of the emission ratios at long, and their high values, at short wave-lengths. AUTHOR.

585. Piezoelectric Oscillators. H. Straubel. *Phys. Zeits.* 32. *pp.* 586–587, *Aug.* 1, 1931. *Paper read before the Deut. Phys. Gesell., Jena, May and June,* 1931.—It has been shown previously [see Abstract 3942 (1931)] that by suitably shaping the contour of a quartz crystal the occurrence of any but a single frequency can be prevented. Two crystals of identical thickness, one circular and the other shaped as required by theory, the surface areas being very nearly equal, were tested in an oscillator circuit. The circular crystal gave a large number of subsidiary frequency responses while the shaped crystal gave a single frequency only. Kinematograph records of the oscillations of circular crystals show the existence of many complex types of mechanical oscillation. A. W.

586. Excitation of Very High-Frequency Oscillations by Spark Methods. K. Haupt. *Zeits. f. Hochfrequenztechn.* 38. *pp.* 57–66, *Aug.*, 1931.—An investigation was made of Busse's method of generating very high frequencies [see Abstract 1462B (1928)]. The effect of cooling the electrodes, the useful life of the oscillator and the oscillation intensity were investigated, as well as the dependence of the damping on the electrode distance and material, on the cooling and the supply frequency. The results obtained show that by the use of internal cooling of the electrodes with water in place of surface cooling by gas, particularly in the case of unsuitable electrode material, a greater useful life and higher constancy of frequency of the oscillator can be obtained. Tungsten and " platit " were found to give the best results, both as regards intensity of oscillations and useful life. Cooling of these metals by means of coal gas was found to be completely useless. The damping was lowered by reduction of the electrode distance, and by raising the supply frequency. With most metals cooling by coal gas also lowered the damping, while water cooling increased it. A. W.

587. Generation of Electron Oscillations of the Barkhausen-Kurz Type. W. J. Kalinin. *Ann. d. Physik,* 11. 1. *pp.* 113–128, *Sept.* 2, 1931.—An experimental study was made of oscillations of the Barkhausen-

Kurz type using two different valves, one being of the very high-vacuum type and the other containing a slight amount of gas at a pressure of 0·007 mm. The results obtained with these valves show that the condition given by Barkhausen and Kurz, $\lambda^2 V_g = \text{const.}$, should be replaced by the condition $\lambda^2 V_g = aV_g + b$, where a and b are constants for a particular valve. Three different kinds of oscillation region are distinguished: (1) regions in which $a > 0$ and $b \neq 0$, as in the case of the highly evacuated valve; (2) regions in which $a > 0$ and $b = 0$, the wavelength in this case being constant; (3) regions in which $a < 0$ and $b \neq 0$, these being very limited in extent. The two latter are only found in the case of the valve with residual gas. A. W.

588. Plasma-Electron Resonance, Plasma Resonance and Plasma Shape. L. Tonks. *Phys. Rev.* 38. *pp.* 1219–1223, *Sept.* 15, 1931.—Plasma-electron resonance is a completely internal oscillation in a plasma and has a frequency dependent only on the electron density, whereas plasma resonance depends upon boundary conditions as well. The frequency of neither is influenced by the Debye-Hückel ion cloud. Previous theory relating plasma-resonance frequency to plasma shape is amplified and demonstrated experimentally. [See also Abstract 3585 (1931).] AUTHOR.

589. Electrical and Magnetic Properties of Metals. R. Becker. *Zeits. f. Elektrochem.* 37. *pp.* 403–412, *Aug.-Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—A review of recent developments in the electron theory of metals on the basis of the Fermi–Dirac statistics. F. J. W.

590. Atomic State in Metallic Lattices from the Basis of Magnetic Measurements. E. Vogt. *Zeits. f. Elektrochem.* 37. *pp.* 460–466; *Disc.*, 466, *Aug.–Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—Measurements are given of the atomic susceptibility of Au-Pd and Pt-Pd alloys. The atomic state in these and other alloys together with the Pd-H system are discussed from the point of view of the evidence given by magnetic measurements. F. J. W.

591. Magnetism of Binary Mixtures: Aqueous Solutions of Acids. J. Farquharson. *Phil. Mag.* 12. *pp.* 283–290, *Aug.*, 1931. *Supplement.*—Curves are found for the change of susceptibility with concentration of hydrochloric and sulphuric acids in water. The former curve shows the presence of the hydrated Cl^- ion in its stages of hydration, and, accepting the highest point on the curve as state in which the Cl^- is most free, a value is computed for the gram-ionic susceptibility of Cl^- equal to $-30{\cdot}66 \times 10^{-6}$. H. H. Ho.

592. Gyromagnetic Effect for Paramagnetic Substances. Part II. Salts of the Iron Group. W. Sucksmith. *Roy. Soc., Proc.* 133. *pp.* 179–188, *Sept.* 1, 1931.—In a previous paper [see Abstract 4110 (1930)] the author gave a description of an apparatus for measuring the gyromagnetic ratio for paramagnetic substances, together with results for dysprosium oxide. In the present paper an account of measurements on salts in the iron group is given with a description of the means employed to obtain the necessary increased sensitivity. The mean value of g_-, the Landé splitting factor, was found to be 2·0 for the ions Co^{+++} and Mn^{++}, and 1·5 and 1·9 respectively for Co^{++} and Fe^{++}. These results show that Hund's theory for the explanation of the paramagnetism of this group is untenable even when modified as proposed by Sommerfeld and Laporte, and by van Vleck. The results, however, agree with Stoner's view that the spin and orbital moments are quantised separately relative to the field axis, and that the orbital moment may be wholly or partially suppressed by the fields of neighbouring ions. J. J. S.

593. Dissymmetry and Flaws in Ferromagnetic Metals. J. Peltier. *Comptes Rendus*, 193. *pp*. 420–421, *Sept*. 7, 1931.—Two equal electromagnets, A and B, are placed with their axes in the same straight line, the cores being in one piece or separate, and so wound that the resultant field in the space between them when a current passes is nil. In this space is placed a secondary circuit, C, wound similarly to A or B, which may be in one or in two equal portions (C′ and C″) with a gap between. This circuit is connected with an amplifier and loud speaker. An unsymmetrical mass of ferromagnetic metal placed near the outer extremities of A and B, or between C′ and C″, causes sounds in the loud speaker: *e.g.*, variations in thickness of an iron tube are readily detected by passing it between C′ and C″ perpendicular to the axis of the coil. [See also Abstract 2446 (1931).] C. A. S.

594. Permeability of Ferromagnetic Substances in H.F. Electromagnetic Fields. N. N. Malov. *Zeits. f. Physik*, 71. 1–2. *pp*. 30–38, *Aug*. 4, 1931.—Describes experiments to measure the h.f. permeabilities of various iron and nickel wires and compares the results with those of Strutt [see Abstract 3223 (1931)]. For nickel wire of 0·1 mm. dia. a linear relation between permeability and frequency is found. Strutt found them to be independent. For iron wire of diameter 0·1 mm. the permeability falls off in a complicated manner as the frequency increases from 2×10^6 to $6 \times 10^6 \sim$, a result like that obtained by Strutt with a wire of diameter 0·0596 mm. Iron wire of diameter 0·043 mm. exhibits a slight peculiarity. N. D.

595. Magnetic Behaviour of Manganese-Ammonium Sulphate Hexa-hydrate at Low Temperatures. K. S. Krishnan. *Zeits. f. Physik*, 71. 3–4. *pp*. 137–140, *Aug*. 15, 1931.—The previously announced result of Jackson and de Haas that the magnetic moment of the Mn^{++} ions in the $MnSO_4 . (NH_4)_2SO_4 . 6H_2O$ crystal, alters with the direction in the crystal is shown to be in error, the mistake being due to a miscalculation. In actual fact the above-named crystal behaves in the orthodox fashion as for other paramagnetic crystals. S. G. B.

596. Variation of Ferromagnetic Quality Made Visible in Solids. L. v. Hámos and P. A. Thiessen. *Zeits. f. Physik*, 71. 7–8. *pp*. 442–444, *Sept*. 3, 1931.—In ferromagnetic material not specially treated, the state of strain may vary from point to point, and this change in elastic state is accompanied by a change in the magnetic state of the material. The variation in magnetic quality has been made visible by the following procedure. A flat surface was ground and polished on the side of a short bar of electrolytic iron. The bar was strained and placed with the flat surface horizontal between the poles of an electromagnet, and a drop of a very fine suspension of pyrophoric iron in alcohol was placed on the surface. In a non-saturation field, the particles settled on the bar in spots which showed the non-homogeneous nature of the magnetisation. Change of the field or of the strain causes a change in the areas of sedimentation.

Etching the bar brings out that the crystallite boundaries do not coincide with those of the sediment. [See also Abstract 3556 (1930).] G. E. A.

597. Shifting of the Curie Point in Nickel by Pressure. D. P. Ray-Chaudhuri. *Zeits. f. Physik,* 71. 7–8. *pp.* 473–477, *Sept.* 3, 1931.—The Curie point of a nickel wire was observed with different stretching weights. The results show that it falls in a manner which agrees qualitatively with Heisenberg's theory, as the stretching increases. There is a remarkable agreement between the curve for the temperature coefficient of the resistance, plotted against the temperature, and that for the stretching, also plotted against the temperature. Attention is called to their similarity to the curve, showing the relation between the specific heat and the temperature in a ferromagnetic substance. H. N. A.

598. Dependence of Magnetic Properties on Elastic Stresses. M. Kersten. *Zeits. f. Physik,* 71. 9–10. *pp.* 553–592, *Sept.* 19, 1931.—The effect of various elastic stress conditions on the initial permeability and on the form of the magnetisation curves for nickel is investigated. Becker's theory [see Abstract 3556 (1930)] is used as basis, of which the essentials are given. The initial permeability can be calculated from Becker's equations for the case in which tension is applied in the same direction as the field. The magnetisation curves of nickel under elastic and plastic bending, including those of Forrer, can be interpreted qualitatively, and in some degree quantitatively also from the distribution of stress set up by the bending. [See also Abstract 2457 (1926).] G. E. A.

599. Magnetic Analysis of Structure. Part I. N. S. Akulov. *Zeits. f. Physik,* 71. 11–12. *pp.* 764–777, *Sept.* 26, 1931.—Shows that the position of the point of maximum curvature of the magnetisation curve of a pseudo isotropic alloy depends mainly on the lattice structure of the elementary crystals which form the alloy. This point of anisotropy becomes veiled and shifted in position by a deformation of the material. The theory is worked out for substances belonging to different crystallographic systems, and it is shown that the ratio of the intensity of magnetisation at the above point of anisotropy to the intensity at saturation is a constant for substances of the same crystallographic system. It is thus possible to obtain the structural data for a new alloy by means of magnetic measurements. H. N. A.

600. Magnetostriction and Hysteresis. W. N. Bond. *Phys. Soc., Proc.* 43. *pp.* 569–571, *Sept.,* 1931.—The magnetostriction of unannealed wrought iron is measured, by means of an optical lever of length 0·12 mm., up to an intensity of magnetisation of 985 e.m.u. The longitudinal extension and the intensity of magnetisation are measured for a cycle of magnetisation, both being found to show hysteresis. The extension is approximately proportional to the square of the intensity but seems to depend slightly on the previous magnetic history as well as on the intensity of magnetisation. This hysteresis indicates that the extension is a consequence of the magnetisation, in the same sense that the magnetisation is a consequence of the applied field. AUTHOR.

601. Generation of Electric Currents by Water Moving in a Magnetic Field. H. C. Regnart. *Univ. Durham Phil. Soc., Proc.* 8. *pp.* 291–300, 1930–1931.—One example of electromagnetic induction should be the production of an e.m.f. between the two sides of a stream of water, flowing across the earth's magnetic field. Faraday attempted to detect such an effect in the Thames at Waterloo Bridge, but failed. The author detected it in sea water by means of plates of rustless steel, 140 yards apart, at the mouth of Cullercoats harbour. In other experiments at Jesmond Dene, a large and variable polarisation e.m.f. at the metal surfaces caused trouble. Faraday's difficulties may have been due to this. The final experiments are made with tap water flowing along a glass tube of 1·5 cm. bore, between the poles of an electromagnet, electrodes being inserted at opposite sides of the tube. With constant magnetic field and variable rate of flow, the mean ratio of observed to calculated value of e.m.f., in five sets of experiments, is 1·013, and with variable field and fixed rate of flow, the mean ratio in four sets of experiments is 1·002. Applications are made to ocean currents, and some numerical values are calculated. N. D.

602. Electronic Charge. W. N. Bond. *Phil. Mag.* 12. *pp.* 632–640, *Sept.*, 1931.—Describes a re-evaluation of e, p, e/m and M_p/m from previous work by the author [see Abstract 1682 (1931)], using the most reliable data. The final results are: $e = (4 \cdot 779_4 \pm 0 \cdot 001_1)10^{-10}$ e.s.u., $h = (6 \cdot 558_8 \pm 0 \cdot 003_1)10^{-27}$ erg/sec., $e/m = (1 \cdot 769_0 \pm 0 \cdot 0004_8)10^7$ e.m.u. g^{-1}, and $M_p/m = 1846 \cdot 5_7 \pm 0 \cdot 4_8$. The value of M_p/m is stated to differ from Eddington's value $(136)^2/10 = 1849 \cdot 6$ by more than six times the probable error. G. E. B.

603. Motion of a Charged Particle. Part II. C. Störmer. *Zeits. f. Astrophysik*, 3. 3. *pp.* 227–252, *Sept.* 15, 1931.—The electrically charged particle moves under the force produced by a magnetic dipole added to an attraction inversely proportional to the distance from the dipole [see Abstract 233 (1932)]. The orbits at infinity are investigated, the coordinates being found as series of decreasing powers of the arc of the path. G. C. McV.

APPARATUS AND INSTRUMENTS.

604. Portable String Galvanometer for Use at Moderate Frequencies. E. W. Marchant, J. K. Burkitt and A. H. Langley. *Journ. Sci. Instruments*, 8. *pp.* 209–214, *July, and pp.* 241–246, *Aug.*, 1931.—The instrument described has been designed for use in a portable apparatus. The string galvanometer has been constructed with a frequency of vibration of 150–200 per sec. In order to secure critical damping the string is arranged in an oil-filled case, and to maintain proportionality between deflection and current the string is supported at the ends by springs. With this arrangement the deflection is proportional to the current over the whole working range, and with a magnification of 60–80 photographic records can be obtained with the light from an 18-watt 6-volt lamp, the battery for which is easily transportable. The optical system consists of a low-power microscope objective and eyepiece, and is fitted with a double convex lens and a plano-convex cylindrical lens to obtain a sharp image. The motion of the string is recorded by a film camera. The motor for moving the film is spring driven, and a spring-driven time marker is also fitted. In order to identify records a device is fitted for marking notches on the edge of the film. After exposure the film is coiled up in a cylindrical box, a spring-operated knife cutting off the film when the lid of the camera is opened, to enable the film box to be removed. AUTHORS.

605. New Electric Arrangement for the Measurement of Small Displacements. S. Reisch. *Zeits. f. Hochfrequenztechn.* 38. *pp.* 101–111, *Sept.*, 1931.—A brief description is given of various electric micrometer arrangements, with a full Bibliography. The various arrangements are criticised, and then a new type of capacitative displacement measuring apparatus is described which is based on the potential distribution across condensers arranged in series. It is shown that by the use of a differential arrangement the law is almost exactly linear, and there is greater freedom from errors and greater certainty of operation than in the case of other known arrangements. A description of the research apparatus is then given, with typical results. The theoretical capacity sensitivity, $\Delta C/C$, is found to be $2 \cdot 5 \times 10^{-8}$, though this has not yet been experimentally verified. A. W.

606. Standard of Small Capacity Differences. A. C. Bartlett. *Journ. Sci. Instruments*, 8. *pp.* 260–262, *Aug.*, 1931.—A description is given of a condenser the capacity of which can be varied over a range of 15$\mu\mu$F. The scale is divided in 1/100 $\mu\mu$F and the minimum capacity is about 50 $\mu\mu$F. The condenser has been used as a working standard for the measurement of the inter-electrode capacities of triodes. AUTHOR.

607. Two Precision Condenser Bridges. A. Campbell. *Phys. Soc., Proc.* 43. *pp.* 564–568, *Sept.*, 1931.—In Heydweiller's modification of the Carey Foster bridge as ordinarily used (with variable mutual inductance) the capacitance of the condenser can be read directly, but the power-factor has to be deduced by calculation. To facilitate direct reading of both capacitance and power-factor the author has developed two bridge systems, A and B, based on that of Carey Foster. In both of these a fixed mutual inductance M is used and there is no added resistance in the condenser arm. The capacitance $C \doteqdot M/PR$, where P and R are the resistances of the other two arms. To give direct reading for C, P can be varied in simple steps (*e.g.*, 10, 100, 1000, 10,000), giving range multipliers, while R consists of a conductance box reading in millimhos. In system A a fourth arm Q of variable low resistance is added to the bridge. The power-factor is given by $Q/M\omega$, and can be read directly (at given pulsatance ω) if a slide wire is used for Q. In system B the power loss in C is balanced by the addition of impurity to the mutual inductance M by means of a closed-loop circuit variably coupled to both the primary and secondary coils of M. When the resistance of this loop circuit is set proportional to the frequency, the scale of the double inductor which varies the couplings can be graduated to read the power-factor directly. When a simple amplifier is used in the detector circuit, a capacitance range of 100 $\mu\mu$F up to 10 μF can be obtained and a power-factor range from 0·0001 to 0·01 with high accuracy of reading. AUTHOR.

608. Voltage Selective Non-Linear Bridge. C. G. Suits. *Physics*, 1. *pp.* 171–181, *Sept.*, 1931.—The important property of the simple series resonance circuit employing resistance, capacitance and an iron core reactor arranged to saturate is the abrupt increase in current at a certain critical voltage. This phenomenon is identified as a quasi-resonant condition, and is compared to resonance in linear circuits. An experimental study is made of a non-linear bridge circuit comprising two branches of the above type. This bridge is voltage selective in such a manner that the load is only energised through a certain range (of the supply voltage), which may be small. The variation of bridge output voltage (effective) with bridge supply voltage may be critical. In one case it is observed that 0·01 % change in supply voltage changes the output (load) voltage by 100 %. The properties of the bridge circuit are applied to the problem of voltage selective relays which permit the control of many circuits by means of a two wire system. For a bridge comprising identical capacitance and inductance units, but dissimilar resistance, a constant voltage characteristic is noted. AUTHOR.

609. New Method of Measuring Frequencies. A. J. Makower and W. Makower. *Journ. Sci. Instruments*, 8. *pp.* 286–288, *Sept.*, 1931.—The arrangement under electrostatic forces of lycopodium powder in ridges on a moving slate enables a.c. frequencies to be measured by counting the ridges formed. AUTHORS.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

610. Report of Irish Radium Committee for Year 1930. *Roy. Dublin Soc., Proc.* 20. *pp.* 99–117, *Sept.*, 1931.

611. Secondary Radiation Therapy. Part I. W. V. Mayneord. *Brit. J. of Radiology*, 4. *pp.* 369–386, *Aug.*, 1931.—In the treatment of tumours and other diseases by means of X-rays it has been proposed, at various times, to introduce salts of the heavy metals into the tissues, upon the view that secondary X-rays would be emitted from the heavy atoms in the tumour, and such secondary radiation, being more easily absorped, owing to the necessary increase of wave-length and lowered penetration, there would hence be a greater absorption of energy, and presumably an increased curative effect. The author proposes to deal with the two possible methods of utilising such secondary radiation, namely: (1) By the introduction of a mass of metal into a body cavity, secondary radiation from which affects the adjacent tissues. (2) The injection of a metal sol or suspension into the actual tumour. The present paper deals with the second method only, although it is hoped to return to the first method at an early date. The paper treats mathematically the emission of secondary radiation from a single particle, and shows that for a large effect the particle must have large X-ray absorption and a small β-ray absorption, and be of large size. An account is then given of certain experimental investigations carried out with a small ionisation chamber, the walls of which were lined by various metallic foils. The results are again discussed from a physical-mathematical aspect. These physical experiments were followed by measurements made by an ionisation chamber, upon " loaded " animal tissues, particularly that of Jensen's rat sarcoma, with and without injected HgS solution. The results are summarised as follows: (*a*) The particles of secondary radiator must be small to avoid internal absorption, *i.e.*, in the particles themselves. Radius certainly $< 10\,\mu$. (*b*) Only moderately heavy or very heavy metals seem likely to be useful as secondary radiators. (*c*) There is an optimum region of wave-length to be used if such a metal is employed. (*d*) Amounts of heavy metal of the order of 1 mg. per c.c. of tissue are required to produce an appreciable effect. (*e*) The secondary β radiation, which alone is effective owing to the small amounts of radiator possible, is almost completely absorbed by thickness of tissue of the order of 50 μ, and it is therefore essential that the secondary radiators be brought into very intimate contact with the cells to be affected if any effective increased dose is to ensue. B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

612. Adsorption and Capillary Condensation. P. Kubelka. *Zeits. f. Elektrochem.* 37. *pp.* 637–640; *Disc.*, 640–641, *Aug.–Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—Reference is made to the work of Zsigmondy, Bachmann, Anderson and Patrick who have shown that capillary condensation plays in certain circumstances an important part between the equilibrium of a capillary structure such as silicic acid gel, active charcoal, etc., and a gas undergoing adsorption. The equation of Thomson is investigated both theoretically and practically, and it is shown that the laws of capillary condensation have wider application than was previously held. J. K.

613. Adsorption Phenomena of Mercury. H. Cassel. *Zeits. f. Elektrochem.* 37. *pp.* 642–645, *Aug.–Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—It is pointed out that for non-fissured surfaces it is not possible to obtain concordant results if these investigations refer to the solid state, while for crystals each crystalline surface at least has to be considered separately. The author therefore decided to work with molten substances, and chose mercury as a very suitable substance for this purpose. The application of the Gibbs equation in this connection is considered. The relationship between dipole moment, molecular refraction and adsorption on a mercury surface at different pressures is examined for such substances as nitromethane, phenol, water, methyl alcohol, ethyl alcohol, ethyl ether and benzene. J. K.

614. Applicability of the Traube Rule for Active Sugar Charcoal. E. Landt and W. Knop. *Zeits. f. Elektrochem.* 37. *pp.* 645–651; *Disc.*, 651, *Aug.-Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—Sugar charcoal made active at different temperatures is examined in connection with valeric acid and propionic acid. J. K.

615. Kinetics of Adsorption of Vapours in an Air Stream. J. K. Syrkin and A. J. Kondraschow. *Kolloid Zeits.* 56. *pp.* 295–299, *Sept.*, 1931.—The rate of adsorption of CS_2, C_5H_5N, $(CH_3)_2CH\,.\,CH_2\,.\,OH$ and $(CH_3)_2\,C_2H_5COH$ in a temperature interval of 10°–100° in an air stream is examined by means of charcoal. The results can be expressed by the formula $\log(A/A-e) = 0\cdot434\,Kt$, where K is a constant, C = the amount adsorbed in gm. and A is the equilibrium concentration. The constant K rises with the temperature. J. K.

616. Adsorption Phenomena on Vacuum-Sublimed Barium Fluoride Layers. J. H. de Boer. *Zeits. f. phys. Chem.* 14. *Abt.B.* 2. *pp.* 149–165, *Sept.*, 1931.—From an investigation of the adsorption of iodine by vacuum-sublimed BaF_2 layers and a comparison with the results obtained for CaF_2 it is deduced that the fluor-ions are arranged on the outer side of these layers. This is confirmed by optical investigations. [See also Abstract 800 (1930).] J. K.

617. Molecular Structure and Solvation. W. Haller. *Kolloid Zeits.* 56. *pp.* 257–267, *Sept.*, 1931.—To interpret unexplained solvation phenomena, use is made of the molecular structure of lyophile colloids. Chemical and physical investigations show that lyophile colloids consist of long, thin, thread-like molecules which are not to be regarded as rigid and rectilinear, since the free rotation and bending of the linkings indicate that curved and rolled forms also may exist. Owing to heat movement, there occurs a continual alteration of form, corresponding with a pulsating, vibrating Brownian movement. Such thread molecules can fix liquid in two different ways: energetically by adsorption (with diminution of the internal energy) and sterically by immobilisation (primarily energy-free). In swelling, adsorption predominates in the early and immobilisation in the later stages. From the molecular mechanism of immobilisation, laws for the dependency of the swelling pressure on concentration and temperature may be derived, these being in accord with the experimental data. Laws for the viscosity of dilute solutions and its dependency on the molecular magnitude and temperature are also derivable, these also agreeing with experimental results. T. H. P.

618. Formation of Films at Liquid-Liquid Interfaces. J. A. Serrallach and G. Jones. *Indust. and Engin. Chem.* 23. *pp.* 1016–1018, *Sept.*, 1931.—Reference is made among others to the work and views of Bancroft, Harkins, Langmuir, Holmes, Nugent, Limburg and Hauser. Special note is made of Hauser's moving microphotographs of particles of rubber latex. These were obtained while piercing a particle with a microscopic glass needle, and show a liquid droplet emerging from the interior through the rupture leaving behind a membrane which formed a skin around the particle. In the present paper are given the most suitable emulsifying agents and the best method of preparation of stable and concentrated emulsions of mineral and of fatty oils in water for the manufacture of industrial products. J. K.

619. Biological Applications of Physics of Disperse Systems. N. v. Raschevsky. *Physics,* 1. *pp.* 143–153, *Sept.*, 1931.—A review of the author's recent theoretical work [see Abstract 2316 (1930)] on the properties of small liquid drops and more generally of systems with very large specific surface, is given. When such a system interacts chemically with the surrounding, in such a way, that the mass of the substances, of which the system is constituted, slowly increases, the system will possess, under very general conditions, properties remarkably similar to those found in living organisms. Thus it is found that such a system may possess a positive rate of growth, when its size exceeds a certain critical one. Below this critical size the rate of growth is negative. Such a system therefore can never be formed spontaneously, although all substances necessary for its formation may be present. Under certain very general conditions such a system will, under the influence of osmotic and other forces, divide into two halves when reaching a certain size, each half again growing and dividing, and so forth. In many cases the system will possess a very definite geometrical form, which will tend to be restored when the system is deformed by some external disturbance. AUTHOR.

620. Limitations and Adaptability of Ultramicroscopes to the Study of Colloid Systems. L. V. Foster. *Physics,* 1. *pp.* 154–159, *Sept.*, 1931.—Ultramicroscopes are of two distinctly different types. The best known is the cardioid ultramicroscope in which the illuminating portion produces a hollow cone of large angular aperture with its apex at the object. The observing system is a microscope consisting of a high aperture objective of angular aperture slightly less than that of the hollow cone and a high power eyepiece. The other is the slit ultramicroscope.

The illumination system in the slit ultramicroscope is perpendicular to the observing system. Both systems are of high numerical aperture, but no direct light can enter the observation system. Details of construction of both types of ultramicroscopes and their sensitiveness of adjustment are discussed. Expressions of their limitations in colloid microscopy are given. AUTHOR.

621. Age-Hardening of Alloys, Particularly of Light Metals and Beryllium. G. Masing. *Zeits. f. Elektrochem.* 37. *pp.* 414–428; *Disc.*, 428–429, *Aug.-Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May*, 1931.—A review.

622. Recrystallisation. G. Tammann. *Zeits. f. Elektrochem.* 37. *pp.* 429–436, *Aug.-Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May*, 1931.—A summary of work relating to the recrystallisation of metals. F. J. W.

623. Crystallisation at Pressures up to 20,000 Atmospheres. G. Welter. *Zeits. f. Metallkunde*, 23. *pp.* 255–259, *Sept.*, 1931.—The crystallisation of several Al-Si alloys from melts under a pressure of about 20,000 atmospheres has been studied. In all cases an improvement in the mechanical properties of the alloys was observed. F. J. W.

624. Effects of Iron on the Electrical Conductivity and Tensile Strength of Aluminium. M. Kuroda. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 14. *pp.* 1–2, *Sept.* 5, 1931. *Supplement.*—The addition of up to about 2 % of Fe to Al increases the electrical conductivity and the tensile strength by amounts proportional to the amount of iron added. F. J. W.

625. Relation Between Temperature and Plasticity of Aluminium Crystals. W. Boas and E. Schmid. *Zeits. f. Physik*, 71. 11–12. *pp.* 703–714, *Sept.* 26, 1931.—Stretching tests on aluminium crystals in the temperature range − 185° to 600° C. have shown that the behaviour of the crystal alters in a marked manner at about 400° C. Up to this point the normal translation described by Taylor and Elam continues to take place. No dependence on temperature of the difference of the hardening of the active and latent octahedral slip systems can be found. There is no increase in stretching with increased temperature up to this point, and the elastic limit does not become more definite. The relation between the hardening and the temperature is much like that which has been found for hexagonal metallic crystals. Above 400° C. begins a new translation mechanism, *viz.*, slip along the cube surfaces in the direction of the surface diagonals. Details are given of the behaviour of crystals with different orientations of the axis. H. N. A.

626. Metallographic Problems of Aluminium and its Alloys. G. Sachs. *Zeits. f. Elektrochem.* 37. *pp.* 436–447, *Aug.-Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May*, 1931.—A review.

627. Physics and Metallography of Magnesium. E. Schmid. *Zeits. f. Elektrochem.* 37. *pp.* 447–459, *Aug.-Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May*, 1931.—The anisotropy of single crystals of magnesium has been studied by measurements of the elastic properties, the thermal expansion and the specific resistance along the directions of the axes of the crystals. The thermal expansion has been

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measured over the temperature range, 20°–200° C. and the specific resistance at 18° C. The plastic deformation has also been studied. Further X-ray analyses have been made of a series of mixed crystals of magnesium with aluminium, zinc and manganese. F. J. W.

628. Electron Diffraction Studies of Gold-Copper Alloys. O. Eisenhut and E. Kaupp. *Zeits. f. Elektrochem.* 37. *pp.* 466–472; *Disc.,* 472–473, *Aug.-Sept.,* 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—The films to be studied are supported upon a mica slip which gives a reference pattern. It is shown that particles as small as 20 Å. are able to give good diffraction patterns. The rate of formation of mixed crystals from gold and copper has been measured by depositing thin films of these metals on top of one another and following the combination by the change in the nature of the diffraction patterns. A rise of temperature of 10° causes the rate of mixed crystal formation to be doubled. F. J. W.

629. X-Ray Studies of Lattice Distortion in Light Metals. J. Hengstenberg and H. Mark. *Zeits. f. Elektrochem.* 37. *pp.* 524–528; *Disc.,* 528, *Aug.-Sept.,* 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—A summary of work already published. F. J. W.

630. X-Ray Analysis of the Copper-Silicon Alloys. S. Arrhenius and A. Westgren. *Zeits. f. phys. Chem.* 14. *Abt. B.* 1. *pp.* 66–79, *Sept.,* 1931.—Five different intermediate phases are encountered in this system. The β contains about 14·5 atomic % Si, and forms a lattice of the hexagonal closest packed type: the dimensions of the elementary cell are $a_1 = 2 \cdot 588$ Å., $a_3 = 4 \cdot 176$ Å., $a_1/a_3 = 1 \cdot 633$. The γ, with about 17 atomic % Si (Cu_5Si) has the same structure as β-manganese; the lattice parameter is 6·210 Å., and there are 20 atoms to the elementary cell. The δ contains about 18 atomic % Si, and has probably a lattice of the deformed γ-brass type. The ϵ, with 21 atomic % Si ($Cu_{15}Si_4$) forms a body-centred cubic lattice. The lattice parameter is 9·694 Å., and there are 76 molecules to the unit cell. The η, with 25 atomic % Si, forms probably a hexagonal lattice. F. J. W.

631. X-Ray Analysis of the Systems Gold-Antimony and Silver-Zinc. O. Nial, A. Almin and A. Westgren. *Zeits. f. phys. Chem.* 14. *Abt. B.* 2. *pp.* 81–90, *Sept.,* 1931.—X-ray analysis of the Au-Sb system confirms the existence of the compound $AuSb_2$. It forms a lattice of the pyrites type with a parameter 6·647 ± 0·005 Å. The Ag-Zn system is very similar to the Ag-Sb system. F. J. W.

632. X-Ray Analysis of the Gold-Tin Alloys. S. Stenbeck and A. Westgren. *Zeits. f. phys. Chem.* 14. *Abt.* B. 2. *pp.* 91–96, *Sept.,* 1931.—The existence of the intermetallic compounds AuSn, $AuSn_2$, and $AuSn_4$ is confirmed. A fourth phase has also been discovered in alloys containing between 12 and 16 atomic % Sn. This phase is of the hexagonal closest packed type, the Au and Sn atoms being arranged irregularly in the lattice. The results of Owen and Preston for AuSn are confirmed. F. J. W.

633. Solution of Aluminium in Alkaline Liquids. G. Schikorr. *Zeits. f. Elektrochem.* 37. *pp.* 610–613; *Disc.,* 613, *Aug.-Sept.,* 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—The corrosion of metals in the presence of water is divided into two groups: (1) Corrosion with the evolution of gaseous hydrogen. (2) Corrosion with oxidation of the atomic hydrogen evolved at the kathode. The corrosion of aluminium in caustic soda solutions was measured by the hydrogen evolved in a definite time at a temperature of 20° C. An incubation period was observed in which no hydrogen was evolved, the reaction then proceeded until the sodium hydrate was converted into sodium aluminate. From the results it was concluded that some modification of the existing views on corrosion is necessary. It is considered desirable to distinguish between the kathodic or anodic reaction which determines the velocity of the reaction. Further work on the subject is outlined. F. J. B.

634. Soil Corrosion of Non-Ferrous Metals and Alloys, Metallic Coatings and Ferrous Pipes. K. H. Logan. *Bureau of Standards, J. of Research*, 7. *pp.* 585–605, *Sept.*, 1931.—This paper presents the results of the examination of specimens of non-ferrous materials and metallic protective coatings removed from 45 soils after exposure of from four to six years. Included in the test were specimens of copper and brass pipe, cast and forged brass fittings, galvanised pipe and sheet steel, lead sheet, lead-coated pipe, and lead-coated and galvanised bolts. Data on the rates of corrosion of steel pipe are also presented as a basis for comparison. The non-ferrous metals tested were found to resist corrosion somewhat better than steel, but they were not unaffected by soil action. AUTHOR.

635. Relation of Long Line Currents to Soil Corrosion. S. Gill and W. F. Rogers. *Physics*, 1. *pp.* 194–204, *Sept.*, 1931.—" Stray currents " from street electric railways and the like give rise to rapid corrosion of buried pipe lines. A type of current similar to " stray currents," but which occurs at long distances from any possible external source of electric current, has been found on pipe lines. These currents are known as " long line currents," and are supposed to originate between the soil and the pipe. They frequently follow the pipe for miles without any change in amperage. To determine possible influence of these currents upon corrosion, measurements of their value were made on an 8-inch oil line upon which much corrosion trouble had been experienced. The line was removed from the ground and the extent of corrosion determined by inspection. Electrical resistivities of numerous samples of soil were determined. From the data obtained, the following conclusions are drawn: (1) Discharge or accumulation of electric currents of the class which have been termed " long line currents " is, in general, without influence upon corrosion of buried pipe lines. (2) Electrical resistivity of soil correlates to a certain extent with corrosion of buried pipe; the relationship is not sufficiently consistent to be of practical value. (3) There is no consistent relationship between soil resistivity and the accumulation or discharge of " long line currents." AUTHORS.

636. Aromatic Electronics. H. H. Hodgson. *Univ. Durham Phil. Soc., Proc.* 8. *pp.* 313–322, 1930–1931.—The author first gives an outline of the applications of modern electronic theory to aromatic substitution in general, and refers especially to the works of Robinson and of Ingold. Following the general introduction come applications to the O. N. Witt chromophore theory, with, as a consequence, a more exact definition of an auxochrome, to the decomposition of diazo-salts by aliphatic alcohols, to nitrous acid as a nitrating agent, and, finally, to an example of an anionoid reagent seeking a kationoid centre. H. H. Ho.

637. Decomposition of Molecules by Impacts of the Second Order. H. Beutler and W. Eisenschimmel. *Zeits f. Elektrochem.* 37. *pp.* 582–584; *Disc.*, 584, *Aug.–Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—The present paper discusses molecular rearrangements and energy relationships when impacts occur between neon atoms and hydrogen molecules, and also between mercury vapour and gaseous alkaline halides. H. H. Ho.

638. Action of β- and γ-Radium Radiation upon Isobutyl and Benzyl Alcohols. A. Kailan. *Akad. Wiss. Wien, Ber.* 140. 2*a*. 7. *pp.* 419–431, 1931.—Experiments are described in which radiation from radium ($0\cdot11$ gm.) was allowed to act for half a year upon 100 c.c. of (1) pure isobutyl alcohol, (2) a solution of the latter in an equal volume of benzene, (3) pure benzyl alcohol, and (4) a solution of the latter in benzene. If m be the number of molecules of monobasic acid which are formed in the radiated liquid in excess of those in the non-radiated liquid, then for (1), (2), (3) and (4) $m = 1\cdot5 \times 10^{13}$, $1\cdot1 \times 10^{13}$, $8\cdot5 \times 10^{13}$, and $3\cdot8 \times 10^{13}$ respectively. If n be the number of ionic pairs which are produced by the absorbed part of the β- and γ-radiation, then $m/n = 0\cdot37$, $0\cdot24$, $1\cdot7$, $0\cdot82$ respectively. Whereas isobutyl alcohol gives rise to a considerable amount of aldehyde, benzyl alcohol does not. On the other hand, isobutyl alcohol with and without benzene has its specific conductivity only slightly affected by radiation, whereas benzyl alcohol has this value increased by over 150-fold. H. H. Ho.

639. Chemical Valency and Characteristics of Spectral Terms. A. T. Williams. *Univ. Nac. La Plata, Estudio Ciencias,* 5. *No.* 93. *pp.* 377–390, 1931.—For all the valencies of the elements of the first and second groups of the periodic classification and the aluminium sub-group, and of carbon, nitrogen, oxygen and the halogens, the sum of the heteropolar and homopolar valencies is equal to R − 1, where R is the spectral multiplicity. The relationship, first quoted by Narayan and Rao for the aluminium sub-group, between the numerical differences of the spectral terms and the change of valency for groups of elements having analogous electronic configurations, has been extended to include the carbon, nitrogen, oxygen and copper sub-groups. H. F. G.

640. Spectrographic Identification of Intermediary Oxides of Nitrogen in the Reaction between Nitrogen Pentoxide and Ozone. G. Sprenger. *Zeits. f. Elektrochem.* 37. *pp.* 674–678, *Aug.–Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—The reaction between N_2O_5 and O_3 has been investigated between 20° and 40° C. over wide variations of concentration. So long as O_3 is present in the reaction mixture, the N_2O_5 concentration remains practically constant so that the reaction is then a decomposition of ozone. Following this reaction comes the decomposition of the nitrogen peroxide in which NO_3 is found to be an intermediary product from spectroscopic data. The kinetics of the reactions are worked out in detail, tables of data being included.
H. H. Ho.

641. Chemical Action in the Glow Discharge. Part VI. Oxidation of Carbon Monoxide. Part VII. Dissociation and Oxidation of Methane. A. K. Brewer and P. D. Kueck. *J. Phys. Chem.* 35. *pp.* 1281–1302, *May,* 1931.—The method used is that previously described [see Abstract 2359 (1930)]. Results closely resemble those with H_2, chain reactions occurring in both. Electric discharge in a $2CO + O_2$ mixture at $-192°$ gives CO_2, with excess of CO or with CO alone a suboxide is formed. In the negative glow the rate of oxidation is nearly independent of pressure, proportional to current, accelerated by excess of CO, retarded by one of O_2, the CO_2 formed reaches the wall as positive ions. In the positive column the rate is independent of pressure below 10 mm. and proportional to the current. At higher pressures it increases rapidly to the ignition point; the CO_2 formed is deposited mainly as neutral molecules. These facts indicate ion clusters in the negative glow, ion chains in the positive column. In the former $M/N = 2$. At $-192°$ in the glow discharge CH_4 is converted quantitatively into $C_2H_4 + H_2$, 3·1 molecules being formed per electron of current. The reaction is $(CH_4)^+ + CH_4 \rightarrow (C_2H_4)^+ + 2H_2$, *i.e.*, $M/N = 1$. At room temperature much greyish-yellow deposit is formed. In a $CH_4 + 2H_2$ mixture only CO_2 and H_2O are formed. The rate of oxidation is increased by excess of CH_4, with a maximum for $CH_4 + O_2$. It is retarded by excess of O_2, less so by A, at first accelerated and then retarded by He. The reaction is initiated by CH_4^+ ions. It is most pronounced in the negative glow, negligible in the dark spaces, and fairly constant in the positive column. M/N observed is 7, but probably really 6. Ionic chain reactions are probable as the efficiency of the positive column increases rapidly with pressures above 5·5 mm. C. A. S.

642. Possible Existence of Free Hydroxyl Radicals. K. F. Bonhoeffer and T. G. Pearson. *Zeits. f. phys. Chem.* 14. *Abt.B.* 1. *pp.* 1–8, *Sept.*, 1931.—The mechanics of electrical discharge of water vapour is examined both spectroscopically and chemically. It would seem that the primary process of decomposition of a water molecule is to produce an excited OH-radical and a normal H atom. The non-excited OH radicals formed from the excited radicals have a very short life (about 10^{-3} sec.), and so no high concentration of these is attained. They probably react as follows: $OH + OH = H_2O + O$, so probably the complete mechanism for the decomposition of water vapour is $H_2O \rightarrow OH' + H$, $OH' \rightarrow OH$, $OH + OH = H_2O + O$, $H + H = H_2$, $O + O = O_2$. J. K.

643. Heat of Formation of Water and the Heats of Combustion of Methane and Carbon Monoxide. A Correction. F. D. Rossini. *Bureau of Standards, J. of Research*, 7. *pp.* 329–330, *Aug.*, 1931.—Withdraws the pressure corrections originally applied to the individual experiments in this research [see Abstract 2097 (1931)] but without altering the final "best" values, since the mean pressure over all the experiments differed but little from one atmosphere. J. H. A.

644. Explosions in Closed Cylinders. Part V. Effect of Restrictions. W. A. Kirkby and R. V. Wheeler. *Chem. Soc., J. pp.* 2303–2306, *Sept.*, 1931.—The closed cylinder used is of gun-metal of 10 cm. internal diameter and 171·4 cm. long. The release of energy as the flame travels through the restrictions is remarkably rapid. There is an almost instantaneous increase of pressure of about 4 atmospheres. A description of the cylinder and manometer has been given previously [see Abstract 2867 (1931)]. J. K.

645. Ignition of Gases. Part VI. Ignition by a Heated Surface. Mixtures of CH_4 with O_2 and N_2, A or He. C. A. Naylor and R. V. Wheeler. *Chem. Soc., J. pp.* 2456–2467, *Sept.*, 1931.—In the present paper the lag on ignition of methane-air mixtures is studied, the mixture, including sometimes an inert gas, N_2, A or He, being rapidly admitted to an evacuated quartz vessel heated to the desired temperature. It is shown that the reactions resulting in the production of flame are thermal reactions catalysed by the products of an initial slow and flameless combustion. Formaldehyde and carbon monoxide are formed during the period of lag, and it is demonstrated in separate experiments that small quantities of these substances lower the ignition temperature and shorten the lag on ignition. On the other hand, traces of iodine, ethyl iodide, lead tetraethyl, etc. (" inhibitors ") raise the ignition temperature and decrease the rate of the reactions that occur below the ignition temperature. Tables and curves are given in illustration of the various points considered. T. B.

646. " After-Burning " during Gaseous Explosions. Its Ability to Cause Explosions. O. C. de C. Ellis and R. V. Wheeler. *Chem. Soc., J. pp.* 2467–2472, *Sept.*, 1931.—" After-burning " is a phenomenon of reluminescence during gaseous explosions which is first manifested near the point of ignition and spreads outward from that point. By a special arrangement of apparatus these reluminescent gases are projected into a vessel containing a fresh explosive mixture of either CH_4 and air or CO and air, and the conditions of ignition of these mixtures are explored. Photographs in illustration of the results are given. When the after-burning gas is CO and air and the other explosive mixture is CH_4 and air there is rather a long lag on ignition, but not when the mixtures are reversed. With CO and air mixtures in both vessels ignition is obtained with all mixtures containing between 22 and 29·4 % of CO. Other interesting phenomena in connection with after-burning are discussed. T. B.

647. Dependence of Reaction Velocity on Surface and Agitation. Part II. Experimental Procedure in Study of Surface. A. W. Hixson and J. H. Crowell. *Indust. and Engin. Chem.* 23. *pp.* 1002–1009, *Sept.*, 1931.—The cube-root law [see Abstract 266 (1932)] is experimentally verified throughout widely varying conditions in the study of heterogeneous reaction kinetics in solid-liquid dissolution systems, both organic and inorganic. Experimental verification in the solid-gas system, naphthalene-air, has also been effected, and the influence of certain variables has been studied. A study is described of the solid-liquid chemical system, alum-aqueous ammonia, and the effects of protective coatings on the operation of the law are explained. T. H. P.

648. Periodic Physico-Chemical Phenomena. E. S. Hedges. *Nature*, 128. *pp.* 398–401, *Sept.* 5, 1931.—Temporal and spatial periodicities are at least as frequently encountered in purely inorganic physicochemical systems as in biological organisms. Periodic chemical reactions include the intermittent action of Hg on H_2O_2 with alkalinity between somewhat narrow limits, oxygen being evolved at the interface at regular intervals of about one minute and the mercury becoming covered with a film of oxide between these intervals. Study of this reaction and of the periodic dissolution of metals in acids, etc., has shown that such periodicity is realised only in presence of a foreign substance, which may be present in extremely small amount. Periodic phenomena are observed also at electrodes during electrolysis, periodic changes of considerable magnitude occurring in the electrode potential and current density; these are usually accompanied by visible periodic changes at the electrode, such as the intermittent evolution of gas or the formation of a film. The conditions necessary for these effects have been determined. Periodic precipitation in chemical reactions is a very general phenomenon. In the formation of such periodic structures and in the production of periodic reactions, in which the reaction velocity varies periodically, the essential condition appears to be the existence of some critical condition determining a change of state proceeding to completion once the critical value is reached. T. H. P.

649. Theory of the Dissolution of Metals. M. Straumanis. *Zeits. f. phys. Chem.* 156. *Abt.A.* 2. *pp.* 150–158, *Sept.*, 1931.—Both thermodynamically and also from the standpoint of the theory of crystal growth, it may be shown that different faces of a metallic crystal must possess the same electrochemical equilibrium potential, assuming that the valency of the ions does not change. Consequently, permanent differences in the velocity of dissolution of different faces of a crystal cannot be attributed to differences of potential. Such differences may be explained by the different positions of the regularly-arranged inclusion layers—always present in the crystal—in relation to the faces, since the factors determining the magnitude of the velocity of dissolution, namely, the number of elements per sq. cm., their resistance, and the overpotential of the kathodes, are influenced by such positions. T. H. P.

650. Properties of the Glass Electrode. G. Buchböck. *Zeits. f. phys. Chem.* 156. *Abt.A.* 3. *pp.* 232–236, *Sept.*, 1931.—The existence of a definite e.m.f. in a glass cell when the combination is symmetrical is explained on the basis of a difference of solution tension of the two glass surfaces, brought about by the stresses in the glass. A method for the measurement of the e.m.f. of glass cells is described. F. J. B.

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651. Electrode Potentials and Adsorbed Ionic Films. H. V. Tartar and H. K. McClain. *Am. Chem. Soc., J.* 53. *pp.* 3201–3212, *Sept.*, 1931.—When the distance between two platinum electrodes in solutions of certain salts in contact with air or oxygen is altered the potential between the electrodes changes. This effect supports the authors' hypothesis that the electrode potential is determined by the preferential adsorption of ions by the electrode and that the adsorbed film extends to an appreciable distance from the surface of the metal; the concentrations of the ions on the electrode change as the distance increases, and finally become the same as in the bulk of the solution. When two electrodes approach, the potential is constant until the two ionic layers come into contact, and when the distance becomes sufficiently small the ions interpenetrate and the potential changes. H. F. G.

652. Hydrogen Effect. L. Wolf. *Zeits. f. Elektrochem.* 37. *pp.* 619–622; *Disc.*, 622–623, *Aug.–Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May*, 1931.—The determination of the activity of solutions which contain only substances capable of behaving as buffers gave different values when the measurements were made by electrometric or colorimetric methods. In the majority of instances the electrometric method showed a greater increase in activity compared with the colorimetric when neutral salts were added to the buffer solution. The differences were measured for a number of different indicators and solutions of sodium phosphate containing potassium chloride as a neutral salt. The hydrogen effect was dependent upon the concentration of the neutral salt, and had the same value for KCl as for NaCl. The results showed that the hydrogen effect was a constant which depended upon the indicator. F. J. B.

653. Absolute Potentials and Sources of Error in their Determination. J. Billiter. *Zeits. f. Elektrochem.* 37. *pp.* 736–739; *Disc.*, 739–740, *Aug.–Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May*, 1931.—The methods for the determination of the absolute potentials of metals, electrocapillary curves and the dropping electrode, are shown to lead to differing results. The causes of the discrepancies are to be sought in the hydrogen and oxygen occluded by the metals. The redetermination of the absolute potentials is considered necessary in order to clear up the differences recorded in the literature. F. J. B.

654. Cataphoresis of Amino-Compounds. H. R. Kruyt and J. J. Went. *K. Akad. Amsterdam, Proc.* 34. 7. *pp.* 1007–1012, 1931.—Although experimental data showing that the presence of an amino-group in an organic compound leads to a positive electrokinetic potential, it is generally assumed that, in colloidal protein solutions, a positive charge arises on the protein particles, since in acid solution the amino-group combines with the acid and the kation goes to form the inner layer of the electrical double layer. Similarly, in alkaline solution, negatively charged particles are formed. The results of measurements of the cataphoretic velocities of sols of a number of organic amino-compounds show that the amino-group undoubtedly gives rise to a positive charge, and are hence in harmony with the theory of the proteins outlined above. T. H. P.

655. Electroendosmosis and Electrolytic Water-Transport. Part II. H. C. Hepburn. *Phys. Soc., Proc.* 43. *pp.* 524–537; *Disc.*, 537, *Sept.*, 1931.—A new and convenient form of apparatus is described for the measurement of liquid-transport produced by the application of an electric field across a diaphragm of parchment paper. Results obtained with solutions of copper sulphate over the concentration range $0{\cdot}0005\ N$ to $1\ N$ are compared with corresponding results obtained previously [see Abstract 1946 (1927)] with a diaphragm of powdered glass. The liquid-transport per faraday with the parchment diaphragm decreases strongly with increasing concentration up to $0{\cdot}2\ N$, but maintains practically a constant value over the concentration range $0{\cdot}4\ N$ to $1\ N$. This value is compared with that deduced for the electrolytic water-transport per faraday from the values of the experimental Hittorf transport number; and evidence is adduced indicating that there is no increase in the electrolytic water-transport per faraday with decreasing concentration from $0{\cdot}4\ N$. The data for the solutions over the concentration range $0{\cdot}0005\ N$ to $0{\cdot}2\ N$ appear to be consistent with the hypothesis of a composite effect produced by a constant electrolytic water-transport per faraday (of the same magnitude as the observed transport per faraday over the concentration range $0{\cdot}4\ N$ to $1\ N$) and by a specific (electroendosmotic) action of the parchment diaphragm. The determination of electrolytic water-transport is utilised to correct the values of the experimental Hittorf transport number obtained from the data of Hittorf and Metalka. The true transport number in the case of copper sulphate solutions decreases with decreasing concentration from $1\ N$, but the values at concentrations $0{\cdot}125\ N$ and less appear to be little different from that at infinite dilution. AUTHOR.

656. Electrokinetics and the Meaning of Surface Conductivity. J. W. McBain and R. Dubois. *Zeits. f. Elektrochem.* 37. *pp.* 651–655, *Aug.–Sept.,* 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—It is observed that the classical formulæ of electrokinetics do not hold for ordinary magnitudes or for atomic or ionic distances or ionic charges, and also not for liquids. The Laing formulæ for electrokinetic and surface conductivity are considered. The Smoluchowski formula is also considered and experimentally investigated. J. K.

657. Solubilities, Conductivities and Rise of Boiling Points of Inorganic and Organic Compounds in Liquid Hydrogen Fluoride. K. Fredenhagen. *Zeits. f. Elektrochem.* 37. *pp.* 684–694, *Aug.–Sept.,* 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—The solubilities, conductivities and rise of boiling points of a number of inorganic and organic compounds, dissolved in liquid HF were determined. The organic substances included certain hydrocarbons, alcohols, esters and acids of both the aliphatic and aromatic series, together with substances of molecular complexity such as glucose, glucosyl fluorides and cellulose. The results showed that the formation of ions in HF took place in totally different ways from in water. It appears to be incorrect to explain the ionisation on the theory of Arrhenius. The use of HF is recommended as a means of investigating the ionisation of inorganic, and especially organic compounds. F. J. B.

658. Conductivity of Alkali Nitrates in Fluid Ammonia. A. M. Monosson and W. A. Pleskow. *Zeits. f. phys. Chem.* 156. *Abt.A.* 3. *pp.* 176–194, *Sept.,* 1931.—The electrical conductivities of solutions of Li, Na, K, Rb and Cs nitrates in ammonia at − 40° C. have been measured, in concentrations from 10 to 100,000 l. per mol. The observations are in qualitative but not quantitative agreement with the Debye-Hückel theory. J. H. A.

659. E.M.F. in Closed Metallic Circuits at Uniform Temperature. O. Scarpa. *Zeits. f. phys. Chem.* 156. *Abt.A.* 3. *pp.* 225–226, *Sept.,* 1931.—The paper forms a criticism of the work of K. Schwarz [see Abstract 3279 (1931) and following Abstract]. The previous work of the author on the existence of e.m.f.s in metallic circuits at the same temperature is reviewed. The origin of the currents is considered to be the formation of solutions or intermetallic compounds. It is concluded that the voltaic potential series and the various thermoelectric laws are only rigorously true when the metals in contact are indifferent to each other. F. J. B.

660. Transport Potentials and Transport Numbers in Metallic Solutions. K. Schwarz. *Zeits. f. phys. Chem.* 156. *Abt.A.* 3. *pp.* 227–231, *Sept.,* 1931.—Previous work [see Abstract 3279 (1931)] is continued. The transport potentials and the transport numbers of a series of dilute amalgams were measured. The amalgams were those of zinc, thallium, tin, bismuth, gold and lead. The concentrations of the metals in the amalgams varied from 0·25 % to 2·0 %. [See also preceding Abstract.] F. J. B.

661. Transport Numbers and Constitution of Aqueous Solutions. P. van Rysselberghe. *Zeits. f. Elektrochem.* 37. *pp.* 694–698; *Disc.,* 698, *Aug.–Sept.,* 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—The paper forms the commencement of a systematic treatment of the theory of complex ions. The present views of chemical unions and the formation of complex ions are discussed. Abnormal transport numbers are explained on the basis of such complex ion formation, which is considered to be due to the stabilisation of the electron shell of simple anions by the agency of simple kations, and to the polarisation of the kations by the anions. Distinction is drawn between chemical and physical complexes. F. J. B.

662. Individual Properties of Electrolytic Solutions and Those due to Charge. E. Lange and H. Streeck. *Zeits. f. Elektrochem.* 37. *pp.* 698–704; *Disc.,* 710–711, *Aug.–Sept.,* 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—Theoretical considerations led to the conclusion that the individual properties of equivalent salts at a sufficient degree of dilution were dependent upon the electrical charge on the ions. Measurements of the heats of dilution of 17 mono- and divalent salts showed that at a dilution of 1/5000 molecular weight the solutions had marked differences. The Debye-Hückel theory is not sufficient entirely to explain the behaviour of extremely dilute solutions, although it accounts for effects due to electrical charge. F. J. B.

663. Molar Volume of Dissolved Electrolytes. Part II. O. Redlich and P. Rosenfeld. *Zeits. f. Elektrochem.* 37. *pp.* 705–710; *Disc.,* 710–711, *Aug.–Sept.,* 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—This paper continues previous work [see Abstract 3665 (1931)] and discusses the factor independent of the nature of the electrolyte which is contained in the square-root law derived on the Debye-Hückel theory of electrolytes for the concentration dependence of the partial molecular volume and the apparent molecular volume. It is shown that the molecular volumes are given by more or less crooked curves having a common boundary inclination. Data afforded by the alkali halides are discussed in this connection, and in the case of methy-alcohol solutions satisfactory confirmation of the theory is obtained. It is shown that a theoretical basis exists for the inter- and extrapolation of molecular volume. Empirical relationships are derived between the volume contraction of electrolytes dissolved in water on the one hand and the concentration dependence of molecular volume on the other in dependence upon the temperature and nature of the dissolved salt. H. H. Ho.

664. Velocity of Diffusion of Strong Electrolytes in Dilute Solutions. G. S. Hartley. *Phil. Mag.* 12. *pp.* 473–488, *Aug.,* 1931.—A theory is given considering the diffusion velocity of strong electrolytes in the light of activity functions and indicating the importance of diffusion velocity measurements to the modern theory of strong electrolytes. In a table the experimental values of the ratios of diffusion coefficients for various electrolytes are compared with values obtained by three theories. H. M. B.

665. General Theory of Solutions of Strong Electrolytes. T. S. Wheeler. *Phys. Zeits.* 32. *pp.* 674–680, *Sept.* 1, 1931.—The expression for the electrical dilution work of a dilute solution of a strong electrolyte the ions of which attract or repel one another according to a law of force of which the Coulomb law represents a particular case, is expressed by the sum of a series of terms. Each term consists of a static potential energy related to the law of force, multiplied by a power of the ratio of this energy to a kinetic energy. The Clausius virial equation may be derived from the expression obtained. The general form of various thermodynamic functions derivable from the work function is given. The relationships of the general expression to special formulations according to the theories of Ghosh, Milner and Debye and Hückel are indicated. T. H. P.

666. Electrolytic Valve Action. Part II. Oxide Layer of Sb, Bi, W, Zr, Al, Zn, Mg. A. Güntherschulze and H. Betz. *Zeits f. Elektrochem.* 37. *pp.* 726–733; *Disc.,* 733–734, *Aug.-Sept.,* 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—Results are given which indicate that, contrary to former opinion [see Abstract 2897 (1931)], the layer active in electrolytic valve action is a compact, non-porous layer of oxide. When this layer is subjected to a potential far lower than that of formation, it behaves like a very high ohmic resistance with pure electronic conduction. Hence arriving anions give up their electron charge to the outer side of the layer and oxygen is liberated. With the extremely small currents possible at these low voltages, the oxygen is completely dissolved by the electrolyte. At a definite critical strength of field in the layer, the electrical forces exerted on the negative oxygen ion lattice and on the positive metal ion lattice become so great that the two lattices begin to undergo displacement towards one another. In this way free metallic ions arrive at the surface and there fix new oxygen ions, so that the layer begins to grow. Ta, Bi, Sb, Zr, W and Al show electrolytic valve action, which is, however, scarcely appreciable with Zn, Cd and Mg. T. H. P.

667. Electrolytic Production of Pure Cerium. M. Billy and F. Trombe. *Comptes Rendus,* 193. *pp.* 421–423, *Sept.* 7, 1931.—A mixture of 25 gm. cerous chloride, 16 gm. potassium chloride, and 2 gm. calcium fluoride is heated to 850° in a small quartz or fluorite crucible placed at the bottom of a larger graphite crucible which forms the anode. The kathode is a rod of molybdenum protected above by a tube of quartz or fluorite, the rotation of which causes the molten salts to rise and so make contact with the anode. With a current of 10 amperes at 12 volts, 9 gm. of cerium of 99·92 % purity was obtained in 1·5 hr., a yield of 70 % metal, the efficiency of the current being 50 %. The m.p. of the metal is 815 ± 5°, and Brinell hardness 42·5. C. A. S.

668. Electrodeposition of Copper in Presence of Gelatin. R. Taft and H. E. Messmore. *J. Phys. Chem.* 34. *pp.* 2585–2618, *Sept.,* 1931.—Observations are described on (1) the effect of adding increasing amounts of gelatin on the form of the kathode deposit obtained from solutions of copper sulphate, and (2) the effect of the presence of gelatin in different concentrations on the mass of the kathode deposit from copper sulphate solutions of various concentrations, various current densities and temperatures being employed. The experimental data are most readily explained by assuming that the copper deposited by the current adsorbs gelatin on its surface. Measurements of the magnitude of the kathodic polarisation in the cell Cu/$CuSO_4$, gelatin/Cu give results which indicate that complex kations are formed between the cupric ion and the gelatin, but that the electrochemical process occuring at the kathode is primarily discharge of cupric ion. T. H. P.